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OF AGRICULTURAL INTELLIGENCE AND PLANT DISEASES

ABSTRACTS

AGRICULTURAL INTELLIGENCE

GENERAL INFORMATION.

o — **The Agricultural Wealth of the New Hebrides.** — LARGEAU, T. (President of the French Agricultural Syndicate of the New-Hebrides), in the *Revue agricole, Organe de la Chambre d'Agriculture de la Nouvelle Calédonie*, No. 54, pp. 31-52. Noumea, 1917.

The chief crops of the New Hebrides are *coffee*, *cacao*, *copra*, *cotton* and *maize*. Under present conditions these are the only remunerative ones. *Maize*, *vanilla*, *pepper*, *spices* of all kinds, *manioc*, the most varied *textiles*, *rice*, *rye*, *barley*, *bananas*, etc., yield as good crops as elsewhere, but the quality of the labour and economic reasons, do not, for the moment, allow these to be grown advantageously.

This, however, does not apply to *coffee* of which the hardy species recently imported from the Congo through the Botanical Garden of Java, give great promise.

Cacao, of which large plantations were formed when hemileia made its appearance in 1913, has given remarkable results. The cacao of the New Hebrides is in no way inferior in theobromine and butter content to any of the best varieties on the European markets.

For the moment *copra* holds the first place in commercial value among the products sent from the New Hebrides.

Cotton gives excellent results both in quality and yield, but growers seem to be taking less and less interest in this crop which requires much labour for picking. Certain estates which were under favourable conditions in this respect have made very large profits.

Maize, although satisfactory, will never be grown to any but a limited extent on account of heavy freight and the few markets available.

Sandal-wood grows wild in certain parts of the islands. For four years it has been subjected to intensive cutting, which, in view of the impossi-

bility of regulation, shows it will be ruined before long. There are other valuable woods which are not exploited owing to lack of labour and capital.

The following table shows the comparative value of the agricultural products exported from the New Hebrides from 1914-1916.

	1914			1915			1916		
	lbs.	£.	s. d.	lbs.	£.	s. d.	lbs.	£.	s. d.
Cocoa	97 231	3107.17.	5	173 052	5621. 8. 2		9 504 774	19063.17.	5
Coffee	331 811	10742. 5.10		833 851	26994. 4. 7		3 594 079	19231. 8.	
Copra	7 349 185	66085.10. 8		9 017 252	81082.13.11		3 184 332	82600. 8.3	
Cotton	1 524 036	13704. 4. 3		3 486 131	3134.17. 5		862 302	34730. 7.10	
Maize	1 025 235	22593.11. 9		3 333 965	8994. 8. 4		412 756	7532. 8.3	
Sandal-wood	225 869	2813. 9. 0		236 339	2980.10. 0		301 790	4345.10. 2	
Total.		119076.14.11			157032. 8. 5			167354. 1.1	

Almost all the exports rise from year to year, and there will be a considerable increase in 1917.

It should be noted that all these results were obtained in spite of the lack of agricultural instruction, with most primitive tools and without the aid of agriculturists and chemists as is the case in other countries. Under present conditions, if there is sufficient labour, it may be estimated that in 1920, the products will amount to: — 1 500 metric tons of cacao, 6 000 of copra, 1 000 of coffee, 3 000 of cotton and 2 000 of maize, without counting other produce, such as shells and costly woods.

251 — *Gambusia affinis*, a Small Fish Very Useful for the Destruction of Mosquito Larvae. — RAVERET-WATTEL, C., in the *Bulletin de la Société Nationale d'Acclimatation de France*, Year LXIV, No. 12, pp. 445-451. Paris, December, 1917.

Gambusia affinis Baird and Girard is a very small fish (the largest specimens rarely attain a length of 5 cm.) belonging to the family Cyprinodontidae, which closely resemble Cyprinidae in outward appearance, but are differentiated by several characters, notably the presence of teeth many of them are ovoviviparous, as is the genus *Gambusia* (1).

The Gambusias are of no value as food, but are of great utility as their food consists almost wholly in mosquito larvae, of which they destroy great numbers. They are the best fish as destroyers of mosquitoes as they live at the surface of the water (whence the name of "top minnows", given in the United States) and they can live in water so shallow as to be uninhabitable for other species; large numbers of this fish are often found in ponds where the mud is, at times, only covered by 3 cm. of water.

The fish breed easily, on account of their hardiness and the fact that as they are born in an advanced state of development, they are less exposed to various dangers. Experiments made in New Jersey have shown that not only are they easy to breed, but they constitute a hitherto neglected means for controlling mosquitoes wherever the water is sufficiently warm

(1) The name of *Gambusia* is derived from "*Gambusina*", a Cuban word meaning a small or worthless object. (Author).

2 - **The Digestibility of the Dasheen.** — LANGWORTHY, C. F. and HOLMES, A. D., in *U. S. Department of Agriculture, Bulletin No. 612*, pp. 11. Washington, November 8, 1917.

The dasheen and other varieties of the taro (*Colocasia esculenta*) was recently very little known in the United States, but of late the Department of Agriculture has given much attention to the selection of varieties suited to warm districts where the potato does not do well.

The edible part consists of a large central root, which may weigh from 5 lbs., or even more, and by numerous small tubers about the size of sweet potatoes. The dasheen may be cooked in several ways, like the potato, and has a pleasant flavour. As the literature on the subject gives no information on the digestibility of this food, the Department of Agriculture carried out feeding experiments on strong, healthy men on a simple, but mixed diet. The results were: —

Digestibility of the Dasheen.

	Protein	Fat	Carbo- hydrates	Ash
ripe roots and tubers (average of 6 experiments)	79.9 %	90.2 %	97.5 %	79.4 %
perrots and tubers (average of 10 experiments)	80.8	96.1	97.6 %	78.4

The average amount of food eaten daily per subject in all the experiments was 1733.4 gm., giving 1313.6 gm. of water, 41.2 gm. of protein, 9.4 gm. of fat, 230.6 gm. of carbohydrates and 18.6 gm. of ash. The amount of dasheen eaten per man per day varied from 376 gm. to 731 gm. with an average of 547 gm. In no case did such large quantities of dasheen cause physiological disturbances. The results show that the carbohydrates of dasheen, which form one of its principal constituents, have a digestibility which may be compared with that of the potato (99.0 % according to BRYANT and MILLER, 92.4 % according to RUBNER, 99.6 % according to COSTANTINIDIS). There is no perceptible difference between the digestibility of ripe and unripe dasheen. In conclusion, it may be said that dasheen forms an excellent food.

3 - **Hygienic Disadvantages of Using Lime in Breadmaking.** — See No. 344 of this Review.

4 - **Studies and Investigations of the Imperial Institute, London (1).** — *Bulletin of the Imperial Institute*, Vol. XV, No. 2, pp. 177-184, 198-270. London, April-June, 1917.

PRODUCTION AND USES OF RICE. — An article on the cultivation and preparation of rice was published in previous numbers of the *Bulletin of the Imperial Institute* (Vol. XI, p. 634, 1913; Vol. XII, p. 85, 1914), in which the varieties of rice, methods of cultivation and preparation, pests and diseases, were described and an account given of the production of this cereal in the British Empire. The article under review deals with the production

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(1) See also R. January, 1918, No. 5. (Ed.)

and commercial movement of rice, especially in the British Empire, and the use of rice and its derivatives.

The production of rice, as shown by official estimates, for nearly all the rice-growing countries is given in the appended table. The chief omission is China, for which figures are not available.

World's production of rice.

Country	Production (cleaned rice) tons	Country	Production (cleaned rice) tons
India *		Bokhara and Khiva **	40 000
British India (1916-17)	31 079 000	Persia *	250 000
Native States	1 000 000	Mesopotamia *	30 000
Ceylon ** (1915)	172 000	Siam *	2 500 000
Malay: **		Dutch East Indies **	
Straits Settlements	35 000	Java and Madura (1914)	3 494 000
Federated Malay States (1913)	46 000	Sumatra, etc.	750 000
Kelantan	35 000	French Indo-China *	3 500 000
Perlis	7 000	Japan (1915)	8 177 000
British North Borneo ** (1914-15)	9 800	Korea * (1916)	1 758 000
Hong Kong **	15 000	Formosa * (1914)	647 000
Fiji **	9 000	Philippines ** (1915)	491 000
Egypt ** (1914-15)	366 000	Madagascar *	450 000
Uganda **	100	United States ** (1916)	520 000
Nyasaland (1916)	1 300	Mexico ** (1911)	15 000
British Guiana * (1915)	41 000	Guatemala ** (1916)	750
Trinidad **	1 700	Dutch Guiana ** (1914)	300
Italy * (1916)	320 000	Ecuador ** (1917)	15 000
Spain * (1916)	149 000	Peru ** (1915-16)	40 000
Bulgaria ** (1912)	5 000	Brazil *	250 000
Greece **	1 200	Argentina ** (1916)	700
European Russia ** (1913)	256		
Transcaucasia and Russian Tur-		Approximate World's total (for	
kestan ** (1911)	170 000	countries listed)	59 401 000

* Exporting countries, in which production exceeds consumption.

** Importing countries, in which consumption exceeds production. It is doubtful which category the countries without any mark belong.

TAPIOCA STARCH FROM RHODESIA. — Cassava or manioc (*Manihot utilissima*), from the roots of which tapioca and tapioca starch are prepared, has been grown for several years at the Agricultural Experiment Station, Salisbury, Rhodesia. The plant does very well there. The rice when fed to stock produced no ill effect. Some of the starch, prepared experimentally at Salisbury was sent to the Imperial Institute to be examined; it gave the following analysis: —

Moisture 14.4 %; proteins 0.1 %; fat 0.15 %; starch 82.8 %; ash 0.2 %; fibre and matter soluble in water, nil.

A firm of importers stated it to be of good quality and valued it £28 per ton, ex quay Liverpool. Another firm considered it of medium quality and valued it at £20 to £25 per ton, delivered in Dundee.

THE LIME FRUIT IN NIGERIA. — The lime tree (*Citrus medica* var. *acida*) occurs in most parts of British West Africa, and in some places has become naturalised. The fruit is used to some extent locally for the preparation of lime juice, but there is no export trade in either the fruit or its products.

The possibility of utilising the fruit has been investigated by the Government Chemist at Lagos, who sent to the Imperial Institute for examination a sample of fruit, distilled oil of limes, and a sample of citrate of lime. The fruit was found rather small ($1\frac{3}{8}$ to $1\frac{5}{8}$ inches in diameter), but sound and of good quality. There is a very small demand for them on the English market. Analysis showed them to contain: —

Percentage of juice to fruit	57.4
Total solids in juice	10.6 gm. per 100 cc.
Citric acid in juice	8.2 gm. per 100 cc.
Purity of juice (ratio of acid to total solids)	77.0
Percentage of citric acid in entire fruit	4.4

To prepare the oil with the ripe fruit, the juice, skin and pulp are distilled in steam separately and the distillates mixed. The average yield is 0.17 % of the whole fruit. The oil, of a pleasant odour and good quality, was similar in character to the Italian oil distilled from *Citrus medea*: —

Specific gravity at 15° C., 0.8946; optical rotation at 20° C., + 34°4'; refractive index at 20° C., 1.4815.

The citrate of lime was prepared from the concentrated lime-juice in the ordinary way. The yield of juice varied from 6 to 7 fluid oz. per lb. of fruit, and the yield of citrate from 0.55 to 0.6 oz. per lb. of fruit. The same examined contained: —

Moisture 4.9 %; citric acid 70.6 %; calcium carbonate 1 %.

It was stated to be of excellent quality and certain of a ready sale.

PISTACHIO NUTS AND THEIR CULTIVATION. — The pistachio tree (*Pistacia vera*, Linn.) a native of Syria and Persia, is cultivated throughout the sub-tropical Mediterranean region, as well as in the Caucasus and in several parts of western Asia. Its climatic requirements are similar to those of the olive. In its original habitat it may occur at altitudes of 3 000 ft. It prefers light soil, but will grow well in any that is not too damp. It is resistant to wind and can withstand a few degrees of frost in winter, but requires a high summer temperature in order to fruit plentifully. It is commonly held to yield a good harvest only in alternate years. It gives the best results in Tunis, and especially in Sicily, where, in view of the rapidity of its growth, it might be much more widely cultivated than it is. It may be propagated by sowing, grafting or budding. Budding is the most common method, as by this means the tree may bear fruit after 2 or 3 years. Plants grown from seed only bear fruit after 6 or 8 years, and, as the tree is a dioecious Anacardiaceae, it is impossible to foresee whether it will be productive (female). About $\frac{1}{10}$ of the plants are male. Grafting carried out on other species of *Pistacia*, giving more resistant trees which

do well where *P. vera* from seed would not succeed; thus, grafted on *P. Terebinthus* (grown from seed), it will give plants that will bear fruit in Central France. Once established, the pistachio needs little attention but fertilisation must be assured. As a rule one male tree is required to every 4 or 6 female trees, and the distance between a male and female tree should not exceed 20 yards. A male graft may be grown on a female tree or buds from both kinds of trees inserted in the same stock.

It is probable that the cultivation of the pistachio could be considerably extended. It grows readily in Cyprus, where it is commonly budded or grafted on *P. Terebinthus* and *P. Lentiscus* but does not produce well owing to the scarcity of male plants. In the East the fact that the plant is dioecious is not sufficiently appreciated. The tree could probably be grown in India, and its cultivation might be successful in the southern hemisphere, for instance in Australia and South Africa.

Pistachio nuts are an important article of commerce; the imports into France (mainly from Russia and Turkey) in 1913, were 4 280 cwt., and the exports were 3 517 cwt., 1 982 of which went to the United States, the total value being £ 42 888. The composition of the kernel is:—

Water 7.4 %; crude proteins 22.7 %; fat 51.1 %; carbohydrates 13.0 %; cellulose 2.3 %; ash 3.3 %; food units 197.5.

The oil extracted from the kernels has the following constants:—

Specific gravity at 15° C. 0.9185; saponification value 191.0-191.6; iodine value 80.9-87.8 %; solidifying point of fatty acids 13-14° C.

WAX FROM *Ceroxylon andicolum*.— This palm occurs only in western tropical South America, where it is very abundant. The wax, obtained from the leaves, is used in Colombia for making candles, but has not yet been exported. A sample of fine powdered wax of a pale straw colour examined at the Imperial Institute, and the wax obtained after purification, showed the following composition and characters:—

Moisture 1.5 %; ash 0.6 %; wax 92.0 %; dirt (matter insoluble in carbon tetrachloride) 6.5 %; specific gravity at 15° C. 1.018; acid value 19.8; saponification value 73.7-104.4; iodine value 32.8 %; melting point (open tube method) 93° C.

The purified wax is similar in character to carnauba wax (*Copernicia cerifera*), which is obtained chiefly from Brazil, and the candelilla wax (*Euphorbia* sp.), imported from Mexico, but has a higher melting point (that of the two others is 84° C. and 70-72° C. respectively). It would be readily saleable at about the same price as these two waxes, which before the war, fetched from £ 5 to £ 9 per cwt. in the United Kingdom.

The wax must be purified before export. The following method is recommended by the Imperial Institute. The crude wax-dust is placed in canvas or calico bag and immersed in boiling water, the bag being weighted to keep it below the surface. The melted wax rises to the surface, where it is allowed to cool. When cold, the wax is powdered and dried. It is then melted at a gentle heat (not more than 110° C. and not longer than necessary), allowed to solidify and the lower dark layer cut away, and either sold separately or repurified with the next batch.

255 - **Electrical Stimulation of Crops.** — BIRKS, L. and DAVIS, O' D., in *The Journal of Agriculture, New Zealand Department of Agriculture, Industries and Commerce*, Vol. XV, No. 4, pp. 185-190, 2 figs. Wellington, October, 1917.

New Zealand possesses large supplies of hydro-electric power and is in a particularly favourable position to apply this power to cultivation. Preliminary experiments have been made at Christchurch. The first was carried out in a greenhouse 80 feet \times 30 feet in which 1 400 tomato-plants were set out. The house was fitted with lamps, hung 2 feet from the ground, which were kept alight from 9 p. m. till 5 a. m. As the plants grew the lamps were raised, until they were finally covered by the tops of the plants. At the beginning of the experiments the steam-pipes had gone out of order and many plants had been injured by a severe frost before the heating apparatus could be repaired. The plants recovered rapidly and gave a very heavy crop, ripening relatively earlier than those of another glasshouse, where the plants, which were not attacked by frost, were grown under similar conditions but without lighting at night.

A second experiment was carried out to test the possibility of protecting fruit trees against frost by means of 250-watt radiator lamps suspended in the centre of the tree, near the fork, and turned on during the nights when frost was to be feared. Three rows of 8 trees each were used for the experiment, one of pear-trees and two of mixed apples. The radius of action of the heat of the lamp was found to be approximately 1 ft. below the lamp, 4 ft. above it, and 3 ft. all round it horizontally. There were many frosts, two of which were very severe. Electric heating did not appear to have any effect on the pear-trees, but the apple-trees gave a heavier crop and ripened fully a fortnight earlier than those which were not heated by electricity.

The cost of installing electricity for stimulating crops in glasshouses is not prohibitive, working out at about 10 to 20 % of the actual present capital and interest and depreciation cost of the glasshouse. The use of electricity for stimulating plant growth would be very valuable, especially for early crops.

CROPS AND CULTIVATION.

256 - **The Problem of Agricultural Meteorology** (r). — AZZI, G., in *Bollettino del Ministero di Agricoltura, Industria e Commercio*, Series B, pp. 1-10, Rome, 1916, and in *Bollettino bimensuale della Società Meteorologica Italiana*, Series III, Vol. XXXV, Nos. 6-7-8, pp. 25-32; Nos. 9-10, pp. 39-42. Turin, 1917.

THE PRINCIPLES NECESSARY TO THE SOLUTION OF PROBLEMS OF AGRICULTURAL METEOROLOGY. Among the variations in the yields of crops those caused by atmospheric changes hold the first place. These changes are of

(1) In March, 1911, the general Meeting of the Delegates of the States adhering to the International Institute of Agriculture received favourably the proposal of Mr. LOUIS DOR (French Delegate and Vice-President of the Institute) with regard to the international organisation of agricultural meteorology, and decided to send officially the report to the President of the International Committee of Meteorology.

In September, 1912, at a meeting of the Central Meteorological Bureau, Mr. SHAW, Presi-

far greater importance than those due, for example, to the use of fertilisers, to cultivation, etc. For this reason studies aiming at reducing the damage done by meteorological factors deserve the greatest attention. The author has drawn up a very detailed scheme which permits the damage caused by weather to be reduced with certainty, by favouring a more rational adaptation of the various crops to the climates of the different districts.

Three principles are required for the solution of problems of agricultural meteorology: — 1) a knowledge of the critical period; 2) phenological maps; 3) weather charts.

Critical period. — From germination to harvest the plant undergoes great modifications which change its form and structure, so that its requirements, even with regard to the various meteorological factors, vary during the growing period.

The critical period with regard to "rain" is the interval, more or less long, of the growing period during which the plant has an absolute need of a certain minimum quantity of water. If, during the critical period, the total rainfall is below the minimum required for the normal growth of the plant, the harvest will be poor, even though there be abundant rain during the rest of the growing period, and, inversely, if during the critical period, the needs of the plant are satisfied, the harvest will be plentiful, even though the rainfall during the rest of the growing period be scarce and badly distributed.

The critical period of cereals falls during the twenty days preceding earing. If, at this moment, there is not sufficient rain to keep the moisture of the soil above a certain limit, the grain harvest will be seriously compromised.

What has been said for rain may be repeated for all the other factors. A plant may, therefore, have more than one critical period, those of rain, frost, temperature, clouds, etc. One or all of these periods may assert itself and assume importance according to the local conditions of the climate.

The necessity of a detailed physiological and meteorological examination is thus obvious when it is desired to ascertain with exactitude in each district the cause of a failure in the crops and the requisite remedies.

Phenological maps. — In a certain number of stations in different parts of Italy the average date is calculated when the peach, for example, flowers, and the data obtained is marked on the map at points corresponding to the various stations. All the districts, in which flowering occurs in the same decade are included in one zone and the various zones marked in different colours. This gives the phenological map of the flowering of the peach tree.

The critical periods referred to above always coincide with some phase of growth (flowering, earing, etc.), that is to say, to a moment when the

dent of the International Committee of Meteorology, formed a commission of 5 members who drew up a scheme of work to be submitted to the International Committee of Meteorology. The commission, on which were placed other technical specialists, should have met in December, 1914. The war interrupted its work. (See B. Dec. 1912, No. 1605).

plant undergoes great modifications which make it very sensitive to the lack of rain or to other unfavourable meteorological phenomena. Thus, at the flowering stage of fruit trees, a drop in the temperature, which at other moments of growth would have no effect, suffices to compromise seriously the fruit crop.

If the average date of the different stages in the growth of a plant (leafing, flowering, ripening of the fruit) are known, it is possible to determine the period of the year during which the plant is particularly sensitive to the harmful action of certain phenomena, or particularly exacting with regard to humidity, temperature, etc. Thus, if the average date of flowering of a peach tree at a station A is February 5, the critical period of that tree with respect to frost will be the first 10 days of February. The phenological maps, then, make it possible to determine the critical period. For each variety grown there should be as many phenological maps as there are important stages of growth in relation to weather. For cereals these are: 1) germination; 2) earing; 3) flowering; 4) ripening of the grain.

Weather charts. — In 1910, in the province of Bologna, there was no rain during the 20 days preceding earing, which took place on May 15; and the harvest was below the average by about $9\frac{1}{2}$ cwt. per acre. On the other hand, there was abundant rain during the first half of April. By earlier sowing and the use of an earlier variety it would have been possible to bring the earing stage to April 25-30 so as to make the critical moisture period coincide with a more favourable meteorological moment. For this, however, it would be necessary to know at the end of October what the weather could be in spring. It is not possible to make a good weather recast for more than 24 hours, or, at a maximum, 48; *the crops cannot, therefore, be adapted to the weather.* If, however, it is impossible to foretell in advance what will be the atmospheric variations at Bologna and Sciacca (Sicily) during the second half of April, there is no doubt that drought is much more frequent and likely to occur during this period at Sciacca than at Bologna.

If the crops cannot be adapted to the weather, it is possible to adapt them to the climate, which represents the average weather and is expressed by a series of percentages of probability: — probability of frost, drought, storms, winds, etc.

The author applies the term "dry decade" to a period of 10 days where the total rainfall does not exceed 5 mm. By calculating for a certain number of districts over a long period (a minimum of 20 years) the number of times a certain decade has been dry, and comparing these figures to 100, the probability of drought for this decade will be obtained. Assuming that, at the station A, the 2nd. decade of July has been dry 15 times in 20 years, the probability of drought during this period at A will be 75 %.

This percentage is marked on a map at the points corresponding to the different stations. All the points where the probability of drought is from 70 to 100 % form one zone, in which drought is certain; those where the probability is from 30 to 70 % form a second zone, and those where it is from 0 to 30 % form a third zone where drought is very rare during the

decade under consideration. The zones are marked in different colours. In this way a chart will be obtained for each decade which will enable the distribution of *drought* for a given period to be ascertained at glance. Similar charts would be made for *frost* ("cold decade"), *cloud storms and mist*.

AGRICULTURAL METEOROLOGY STATIONS. — The critical period of a plant with regard to a meteorological factor may be restricted to one or two decades. Taking as example the Agricultural School of Imola where agricultural observations are made, and the nearest meteorological observatory that of Bologna, about 20 miles away, it may well happen that during the critical period of moisture for wheat, a shower may fall at Bologna while the drought continues at Imola, or vice versa. A comparison between the phenological and biological data registered at the school and the meteorological data of the observatory may, therefore, lead to erroneous conclusions. It is necessary that the biological and meteorological observations be carried out at the same time and place: — the agricultural meteorology station.

The author considers that an entirely new scheme is unnecessary, more especially as in no case should a new station of agricultural meteorology be built, use being made of those stations and agricultural schools already existing by supplying them with building, technical staff and experimental fields. Each station should have the following instruments: —

- 1) rain-gauge;
- 2) hygroscope;
- 3) maximum and minimum thermometers;
- 4) earth thermometers;
- 5) bore for taking samples of soil at different depths;
- 6) balance, oven, and accessories required for determining the moisture in the sample.

How many stations are necessary? Where environmental conditions are uniform, as in Russia, where similar topographical and climatic conditions prevail over long stretches, the number of stations may be relatively limited. On the contrary, in Italy (as in Greece), with the exception of the valley of the Po, which is fairly uniform, the country varies greatly, even within limited zones, so that it would be necessary to have many stations that the project becomes almost impossible.

Nevertheless, however variable the geographical distribution of meteorological phenomena harmful to crops may be, the nature and significance of the problems of agricultural meteorology remain the same. Thus, in northern Italy, the district in which wheat suffers from lodging includes all the Po valley, but in central and southern Italy, and in the mountain districts, the action of rain with wind is usually discontinuous, often disappearing entirely, without any regularity, in localities sheltered from the wind, according to the topography of the land. The problem, however, is the same in each case: — to create a wheat which is both resistant to lodging and a good producer. If it be assumed that wheat suffers from lodging in 200 stations, if in one of these a wheat with a resistant culm were produced, this type could be introduced with a great

probability of success in all the other 199 stations, wherever they may be situated.

Agricultural research which aimed only at solving well-defined problems connected with analyses of agricultural meteorology could, therefore, be carried out in a relatively small number of stations if it were known at what points and to what extent a certain phenomenon is harmful to a given crop. The agricultural stations, and agricultural schools and institutes forming a network in all the civilised countries of the world could, if adequately fitted up, be used as agricultural meteorology stations. To this list might be added the thermo-hyctometric stations, convents, agents and directors of farms, etc. situated even in most distant lands, who could take observations and help to solve the important problems of agricultural geography and meteorology. Each first class station of agricultural meteorology (agricultural stations and schools), together with the second class stations (thermo-hyctometric) and points of observation (parishes, etc.) dependant on it, form a *fundamental principle of the system (network)*.

TABLES OF GROWTH (*their meaning, construction and use in determining a critical period*). — The data obtained in the stations are collected and classified in tables of growth. Plants are modified during the passage from germination to ripening of the fruit, but the modifications which occur are either gradual nor continuous. There are relatively short phases during which the plant is greatly modified (disappearance of certain organs and formation of new ones); it then remains anatomically and physiologically stationary for a long period, till another phase takes place. There are, thus, *phases of growth* (flowering, earing, etc.) and *interphasal periods* or *subperiods* between two successive phases. It may be assumed that the structure and requirements of a plant remain constant throughout a sub-period.

This phenomenon may be represented by a discontinuous curve, composed, however, of elements almost parallel to the line of the x joined by almost parallel segments to the line y .

The growing period of cereals is divided into sub-periods as follows: —

- 1) from sowing till the seedling appears;
- 2) from this phase till winter interrupts growth;
- 3) from this interruption till growth restarts in spring;
- 4) from the restarting of growth to earing;
- 5) from earing to complete maturity.

For each of these sub-periods there is a special table — table of growth — in which are noted all the meteorological and phenological factors of the plant studied, as, for example: —

Table IV. — Wheat. Station..... Year.....

Fourth sub-period — From restarting of growth to earing.	
1) Variety.
2) Date when growth restarted in the whole field.
3) Remarks on tillering during the 4th sub-period.
By tillering is meant the emission of lateral shoots, which usually takes place in autumn, which may occur in a cold, late spring, as is frequently found in the mountains.	

The average height of 10 normal plants taken haphazard here and there represents the average height of all the plants.

Depth of roots. — A lump of soil, together with all the plants on it, is raised about 6 inches, and the depth measured on the vertical section. This determination is made 3 times: — 1) when growth restarts; 2) 15 days before earing; 3) at the moment of earing.

TABLE II. — *Number of plants and culms; vigour of tillering; average weight of dry mass of plants; number and weight of weeds.*

Month and day	Grasses studied						Weeds			
	Number of plants with:					Total number of culms	Weight in grams of dry seedling	Vigour of tillering	Number of samples	Weight in grams in dry condition
	one culm	two culms	three culms	four culms	many culms	Total number of plants				

1) *Vigour of tillering*. — This is calculated by dividing the total number of culms by the number of plants.

2) *Determination of the weight of the plants and weeds.* — In four different parts of the plot the plants are uprooted from about $\frac{1}{4}$ sq. yard; the seeds are separated from the plant studied; the root system is removed and the green part left to dry; when a constant weight is obtained the value entered in the table.

TABLE III. — *Number of plants and culms; vigour of tillering; vigour of earing; weight of dried mass of the plants; number and weight of weeds.*

[illegible]

N. B. — This table must be filled in at the end of the earing stage.

TABLE IV.

Month	Meteorological observatory											
	Air temperature							With wet-bulb thermometer			Percentage of relative humidity	
	7h.	13h.	21h.	Total	Average	Maximum	Minimum	7h.	13h.	24h.	7h.	13h. 21h. Average

TABLE V. — *Temperature of soil.*

Date	At the surface				In active layer			In virgin layer			In sub-soil		
	7h.	13h.	21h.	Average	7h.	13h.	21h.	Average	7h.	13h.	21h.	Average	Average

TABLE VI.

Date	Rain			Mist			Average	Clouds	Storms	Other meteorological phenomena
	in.	duration		7h.	13h.	21h.				
	(or mm.)									

The table of growth (composed of the above tables) is reproduced because it contains all the material necessary to a complete study of agricultural meteorology. For each variety there will be a table of growth corresponding to each of the interphasal periods.

DETERMINATION OF THE CRITICAL PERIOD. — The yield in fruit is the measure by which the more or less favourable action of meteorological phenomena must be judged. The higher the yield the more favourable was the weather during the growing period in general and the critical periods; particular. If the data concerning wheat at station A from 1901 to 1910 were available the following facts could be deduced: — there is no relation between total precipitation and yield in grain or between yield and total precipitation during the 1st., 2nd. and 3rd. sub-periods. If, however, the data on the yield and total rainfall during the 4th. sub-period are compared, a direct relationship is seen to exist. The critical rain period of wheat then, the 4th sub-period.

By limiting in this way the field of research to a relatively narrow scope it is easy to define exactly a critical period. No important phenological transition is observed between the restarting of growth and the earing phase. The critical period, then, is the earing phase. At this moment the plant does the greatest amount of work by elaborating the enormous quantity of plastic substances necessary for the formation and development of the caryopses and by consuming a great amount of water. There is an average of about 40 days between the earing and ripening phases. During this time occurs the whole process of growth, the last phases succeeding each other rapidly — flowering, development and ripening of the caryopses.

To assure a good wheat harvest abundant rain is necessary during the decade, or two decades, preceding earing so that the plant may have the moisture necessary for rapid and strong growth. In warm countries, where there is a great probability of drought during the earing period, the critical period just mentioned is very evident and has a marked influence on the harvest. In proportion as the cold northern countries where rain is nearly always plentiful at the requisite time are approached, all relation between precipitation and yield disappears, while other critical periods arise, as, for example, an inverse relation between yield and rain during flowering.

The specific action of all the other meteorological factors could be established in a similar way.

THE MANNER IN WHICH KNOWLEDGE OF THE CRITICAL PERIOD, PHENOLOGICAL MAPS AND WEATHER CHARTS PERMITS AN INCREASE OF YIELD BY ADAPTING THE VARIOUS CEREALS TO THE CLIMATE. — When a scale of the yields has been established (e. g. for wheat, cwt of grain per acre) it is possible to distinguish the zones of good, medium and bad harvests. Thus, the zone of good harvests includes districts where the average yield of wheat exceeds 13 cwt. per acre, that of poor harvests where the yield is less than $\frac{1}{2}$ cwt. per acre; the medium zones includes the districts with yields between $9\frac{1}{2}$ and 13 cwt.

The aim of agricultural meteorology is to increase the zone of good harvests at the expense of the other two. Statistics are but a statement of facts; the expression "bad harvest" merely means that the meteorological factors during the period of growth in general and the critical periods in particular are unfavourable to the growth of the plant, but does not show which is the unfavourable factor or the means to remedy it. To do this agricultural meteorological analysis is necessary. Many meteorological phenomena may damage wheat, for example, in Italy. In the south there may be: —

1) warm, dry winds (sirocco, "favonio") which, during the ripening of the ear (5th. sub-period) cause scorching, followed by hastened ripening, drying up of the grain, and, while the plants are still strong, the caryopses lose food material or do not form at all. This is particularly serious in light soils or where there is only a small layer capable of being cultivated and, in some years, within a few days, the yield is reduced by 25, or even 50 %;

2) lack of rain during the 10 or 20 days preceding earing;

3) prolonged drought during the period following sowing.

Rust is little to be feared because excessive humidity in spring occurs rarely and only over very limited areas. Lodging is unknown because in the islands, most of Calabria and in Basilicata hard and semi-hard grain with short, strong straw is grown.

In central and northern Italy, on the contrary, the following factors must be noted with regard to climate: —

1) in the valley of the Po, particularly in the lowest part, wheat is most invariably suffers from excessive moisture which causes rust with resultant serious decrease of yield;

2) lodging caused by wind and heavy rain at the time of the formation and development of the caryopses may lower the yield by 20 to 25 %;

3) considerable damage by late spring frosts.

Such is the knowledge, relatively general, at the present day, when the network of agricultural meteorological stations is to begin its work, aimed at a) the determination of the critical period of wheat with respect to the meteorological factors as discussed above, b) the preparation of phenologic maps, and c) weather charts.

Once the critical period is known the comparison of the phenological maps and weather charts allows the suitability of a plant to local climatic conditions to be easily determined. If, for example, at A, wheat ears on May 10 on an average, and if, during the last decade of April and the first decade of May, the probability of drought is 75 and 90 % respectively, it will show why the average yields in this district are relatively low. On the reason of the poorness of the yield is established it may be remedied three ways:

1) Change the time of the critical period phase and make it coincide with a more favourable meteorological moment.

E. g. the *f* variety of wheat at the station A ears on an average (see phenological map of earing of wheat) on May 12, and the probability of drought during the third decade of April and the first decade of May is 90 and 95 % respectively (see weather charts for drought for the 3rd. decade of April and the 1st. decade of May). This accounts for a low yield. In the first and second decade of April, on the contrary, the probability of drought at A drops to 10 and 15 % respectively. By earlier sowing or by using an earlier type of *f'* wheat, so that earing takes place between April 20 and 25, this drawback could be remedied in part at least.

2) Artificial modification, during the critical period, of meteorological factors, e. g. control of frost by smoke, of drought by irrigation, etc. Brilliant results have been obtained with fruit in California by forecasting cold by 24 to 48 hours, thus allowing growers to decrease or even nullify injurious effects by burning heavy oils or other substances which surround them with thick, protective smoke.

3) The introduction or production of types of increasing resistance to drought, frost, rust, lodging, etc.

Modern experimental research in biology in various countries has clearly shown that, by hybridisation and subsequent selection, it is possible to unite in one variety the good characters existing

distinct varieties and to eliminate undesirable characters. In this particular case the breeder must aim at uniting high yield with resistance to the harmful meteorological character most frequent in the district. Thus, at Svalöf (Sweden), M. NILSSON has obtained types of wheat resistant to cold, and at the same time, excellent yielders by crossing the most productive varieties slightly resistant to cold (English Square-head) with native Swedish wheat very resistant to low temperatures.

This acclimation of non-native types and creation of new types by crossing and selection would be the most important work of agricultural meteorological stations of the 1st. class. In the choice of these, therefore, would be made of agronomic and agricultural Institutes already existing, and not of the meteorological Institutes which may cooperate with them but cannot form centres for new research.

The following example shows that agricultural meteorological study is not only necessary where soil is cultivated for the first time, but that it may give excellent results in districts where intensive culture has been carried out for a long time by determining a better adaptation of crops to the climate of different districts. In the province of Bologna (northern Italy) this farm may be said to grow three varieties of wheat — Rieti, Gentil rosso and Hybride inversable de Vilmorin, distinguished by the following characters:

- 1) RIETI: resistant to rust but lodges easily; in favourable years, when it does not lodge as a result of storms, it yields about $17 \frac{1}{2}$ cwt. per acre;
- 2) GENTIL ROSSO: very subject to rust and lodging; in favourable years, without excessive humidity and destructive storms, it may yield over cwt. per acre;
- 3) HYBRIDE INVERSABLE DE VILMORIN: subject to rust but resistant to lodging; when the humidity is not excessive it may yield $16 \frac{3}{4}$ cwt. per acre.

Gentil rosso and Hybride inversable are of recent introduction, and other varieties, now under observation in various agricultural institutes, will eventually be added to the pre-existing varieties, causing a mixture of wheat which is not always desirable. A single variety best suited to the climate had not been adopted because, it is argued, there is no such variety and one which suffers from the same two causes at the same time, therefore, in any year one variety fails, there is always one which succeeds, thus compensating for the loss. This is false reasoning. Gentil rosso, when it does not lodge, produces up to 19 cwt. per acre, Hybride inversable only $16 \frac{3}{4}$, i.e. $2 \frac{1}{4}$ less; but the first lodges easily, whereas the second does not. Lodging causes a loss of nearly 4 cwt. per acre, thus reducing the yield from 19 to 15 cwt. The probability of heavy rainfall and wind during the 5th. sub-period in the province of Bologna is, moreover, 80 %. In a period of 5 years there would be: — GENTIL ROSSO $19 + (15 \times 4) = 79$ cwt; HYBRIDE INVERSABLE DE VILMORIN $16 \frac{3}{4} \times 5 = 83 \frac{3}{4}$. Thus, in the province of Bologna, where the probability of lodging is 80 %, the Vilmorin hybrid is preferable to Gentil rosso.

When, on the contrary, the probability of storms in the 5th. soil period falls to 20%, GENTIL ROSSO should be preferred: — HYBRIDE DE VIT MORIN $16 \frac{3}{4} \times 5 = 83 \frac{3}{4}$; GENTIL ROSSO $(19 \times 4) + 15 = 89$ cwt.

Agricultural meteorology is, therefore, indispensable if an exact idea of the real productivity of a species in a given district is to be determined.

The mere fact that a given variety of wheat is grown by preference, in a given district is no proof that it is the best suited to this district. New types are often on the market which may completely supersede the native types, to be superseded later in their turn by other new types. In all such cases it is the character "productivity" which guides the farmer in his choice of seed; but productivity is influenced to a marked degree by climatic conditions, and consequently, varies from one district to another, so that the adoption of new types should be preceded by a careful study of agricultural meteorology.

Agricultural meteorology thus gives a twofold result: —

1) it allows a better distribution of the different varieties of a cultivated species; i. e. it shows the districts best suited to each variety from the point of view of local climatic conditions;

2) it guides the selector in his research aiming at uniting to the greatest advantage in a single type, productivity and resistance to the most destructive meteorological phenomena of the different districts.

The work of adapting crops to climate is difficult, but it cannot be expected to lead, in part at least, to positive results, and considering the size and complexity of the problem, these results, even though they be but small, represent large figures.

Unfavourable conditions in Italy diminish the grain harvest, on an average, by over 3 cwt. per acre, and though only $\frac{1}{2}$ cwt. per acre were gained the profit would be 9 432 980 cwt. representing a considerable value.

What has been said for wheat applies equally to all other cultivated plants; what has been said for Italy applies to all the countries of the world. On the other hand, it is seen that the network of agricultural meteorological stations is already outlined by the many agricultural schools and institutes and the thermo-hyctometric stations possessing the premises, instruments, experiment fields and technical staff. All that is required is to collect, co-ordinate and develop all this latent or dispersed activity, so that the development of the formation and upkeep of the new service shall be limited.

257 — **The Relation of Winter Temperature to the Distribution of Winter and Spring Grain in the United States: Why Cereals Winterkill.** — SALMON, S. C., 1. *Journal of the American Society of Agronomy*, Vol. IX, No. 8, pp. 353-380; 11. *Ibid.*, Vol. I, No. 1, pp. 21-24. Washington, 1917.

I. — In northern districts winter cereals usually give a higher yield than spring cereals, but they are much less widely distributed because they are naturally excluded from zones where the climate is too severe to allow young plants to survive the winter. The injurious action of the winter may have four effects: —

1) HEAVING. — This is due to expansion and contraction of the roots by alternate freezing and thawing; the roots are broken and exposed

air. Shallow sown plants suffer least, as the whole plant will then be protected without breakage of the underground parts. Heaving is most common in the eastern States, especially in wet, badly drained plains.

2) **SMOTHERING.** — Alternate freezing and thawing sometimes turn the snow into an ice sheet through which the air cannot pass, thus suffocating the plants by lack of air and accumulation of carbonic acid.

3) **PHYSIOLOGICAL DROUGHT.** — This occurs when the soil is frozen and the plant can no longer obtain moisture from it. All the anatomical characters which tend to limit transpiration should, therefore, be in correlation with resistance to cold. Turkey and Kharkov wheat; winter rye and winter Turf oats, known for their resistance to cold have marked xerophytic structures — narrow leaves and prostrate habit of growth, which partially protect the plant from the action of wind (KOLKUNOW, SINZ, etc.). The author and his collaborators, in a study on several varieties of winter wheat, rye, barley and oats, found no definite relation between resistance to cold, cell structure, epidermal covering and ability to control transpiration. Recent studies have, however, shown that a reduction of the leaf area in relation to the length of the root as expressed by the ratio of root length to leaf area does influence the resistance of young plants to cold. In Turkey wheat this ratio is 25 % greater than in Fultz wheat, a less hardy variety, and 40 % greater than in common oats and barley. Physiological drought may be considered, if not as the only cause of winterkilling, at least as the most important.

4) **DIRECT EFFECT OF LOW TEMPERATURE.** — This acts in many ways: —

a) *Mechanical action.* — Injury to the tissues caused by the formation of ice.

b) *Desiccation of the protoplasm.* — Low temperatures cause withdrawal of water to the intercellular spaces, where it freezes; when later, the ice thaws rapidly the moisture can no longer be absorbed. At -13°C . the loss of water is 63.7 %; at -15.2°C ., 79.2 %.

c) *Coagulation of the proteids.* — In plants resistant to cold this only takes place at very low temperatures; thus for pine needles a temperature of -40°C is required, in winter rye -15° and in begonia, which is very sensitive to cold, -3°C . This coagulation is accompanied by denaturing of the proteids, caused, perhaps, by increased acidity of the sap, so that they can no longer be reabsorbed. This theory is held by GORKE but contradicted by CHANDLER'S experiments, which showed zinc sulphate, one of the salts which readily coagulate proteids, to increase rather than to diminish resistance to cold.

LIDFORSS, in his studies on *Holosteum*, *Cerastium*, *Lamium*, *Veronica*, *Senecio*, *Viola*, *Fumaria*, etc., observed that, on the approach of winter, starch in the tissues of these plants changed to sugar, which, by changing the concentration of the sap, reduces the freezing point. These phenomena of the protective action of various substances due to the lowering of the freezing point have formed the subject of much research (MAXIMOV, etc.), which confirms the theory of LIDFORSS.

II. — The specific action of low winter temperatures on winter ce-

reals is clearly shown by a study comparing the northern boundary of different varieties with the isotherms of the minimum temperatures during January and February.

WINTER WHEAT. — Its northern limit corresponds approximately to the isotherm of 10°F (−12.2° C.). Cold resistant varieties may exceed this limit if the seed is well protected by a covering of snow.

WINTER BARLEY. — Its northern limit coincides with the isotherm of 20°F. (−6.6° C.). It is successfully grown to the west of the Rocky Mountains and to the south of the Ohio and Platte rivers.

WINTER OATS. — Its northern limit corresponds to the isotherm of 30° F (−1.1° C.). They may be grown, in the north, as far as Central Tennessee and Arkansas and southern Maryland and Oklahoma.

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258 — **Effect of Decomposing Organic Matter on the Solubility of certain Inorganic Constituents of the Soil.** — JENSEN, C. A. (Assistant in Plant Malnutrition, Office of Biophysical Investigations, Bureau of Plant Industry, U. S. Department of Agriculture), in the *Journal of Agricultural Research*. Vol. IX, No. 8, pp. 253-266. Washington, May 21, 1917.

The experiments described were undertaken to determine if the beneficial action of decomposing organic substances (humus) is due to the solution of the inorganic substances of the soil, and, if so, to what extent. Water extracts of green barley hay, sweet clover and alfalfa were prepared by saturating 70 gm. of each of these substances in a flask with distilled water, and allowing them to ferment for 14 days. After this period the substances were thoroughly shaken with 1500 cc. of distilled water, and filtered, first through muslin, then through a Chamberland filter. The insoluble residue was again treated in the same manner and other extracts obtained from it. The extracts thus obtained were added to soils in the proportion of 500 cc. of solvent to 250 gm. of soil. The soils used were clay loam and sandy loam.

It was found, in the first place, that by extracting soils with these solutions, two to five times as much calcium was removed as was added in the extracts. In most cases even more magnesium was removed than was added, the increase varying from a small fraction to 80 %. Iron and phosphoric acid were removed in smaller quantities than they were added in the extracts, but the iron dissolved exceeded that dissolved by water by 1.7 to 5.4 times. The solvent action of the different extracts was about the same whether they were prepared from leguminous or non-leguminous plants.

Extracts obtained in a similar way from cow manure removed less calcium from the soil than did vegetable extracts, but their action was the same for the other mineral constituents.

Both the organic and inorganic salts of the aqueous extracts seem to contribute to the solution of the mineral substances of the soil.

Artificial green manures (barley hay, sweet clover, bean straw, alfalfa, etc.) kept moist till thoroughly decomposed, and gave extracts which removed a greater quantity of calcium than was added; they also removed amounts of magnesium, phosphoric acid and iron in excess of those dissolved by water alone. The green manure extracts gave no alkaline

action to phenolphthalein and no acid reaction to methyl orange. When the soil was mixed with 3 % green manure and stable manure and left till partially decomposed, the solubility of the calcium and phosphoric acid increased from 30 to 100 %.

To study the action of the organic constituents of the extracts tested, green manure and sugar were hydrolysed with strong acid, washed till free from acid, then extracted with ammonia. When the ammonia was imbibed these extracts represented artificial humus solutions free from calcium, magnesium, iron and phosphoric acid. These extracts, when added to soil, increased the solubility of the calcium as compared with its solubility in water by amounts varying from a few parts to 240 parts per million of soil. They also increased to a lesser extent the solubility of magnesium, phosphoric acid and iron.

In short, in the soils tested, the solubility of calcium, magnesium, iron and phosphoric acid is appreciably increased by the addition of green manure, stable manure or their extracts. This increase in solubility is due, partly to the action of the inorganic salts contained in these substances, and partly to the solvent action of the organic compounds formed during decomposition. The fact that a deficiency in soluble iron causes certain types of chlorosis suggests that the beneficial effect of the addition of organic matter to citrus soils depends partly on its solvent action on iron and other soil compounds, though this has not yet been definitely proved.

59 - **The Proof of Microbial Agency in the Chemical Transformations of Soil.** - COSSA, H. J. (New York Agricultural Experiment Station), in *Science*, Vol. XLVI, No. 1185, pp. 252-255. Lancaster, Pa., September 14, 1917.

Care must be taken to avoid inexact statements and ill-founded conclusions as to the part microorganisms play in the chemical changes occurring in soil. In soil microbiology there are statements and deductions similar to those found regarding pathology till light was thrown on it by the fundamental postulates laid down by KOCH for the study of pathogenic bacteria.

Extending these postulates, by analogy, to bacterial activity in soil, the author lays down the following principles for research in soil microbiology:

a) The organism to which action is attributed must be shown to be present in the soil in an active form when the chemical change studied is taking place;

b) this organism must be present in larger number, under such conditions, than in the same soil in which the chemical change is not occurring;

c) it must be isolated and studied in pure culture;

d) the same chemical change must be produced by the organism in experimentally inoculated soil, the test being made, if possible, in unsterilised soil.

These facts can be shown by the cultural methods used up to the present. It must, however, be remembered that they may lead to errors because naturally inactive organisms may be present which become active under cultural conditions, or the opposite may occur. Cultural methods must, therefore, be checked by others; the microscope may be useful in this respect, but it may prove necessary to devise entirely new methods.

- 260 - **The Decomposition of Soil Protein Substances Through the Action of Bacteria.**
— ROBINSON, R. H. and TARTAR, H. V., in *The Journal of Biological Chemistry*,
Vol. XXX, No. 1, pp. 135-144. Baltimore, May, 1917.

The experiments described were carried out at the Chemical Laboratory of the Oregon Agricultural Experiment Station, Corvallis. The function of bacteria in the production of ammonia from the protein substances in soil has long been known. How these proteins are acted upon, whether it be a hydrolytic process brought about by enzymatic action, whether it be an oxidative one, or a more complex chemical reaction is still unsolved. This led the author to undertake a series of experiments to ascertain, by controlling the influencing factors as much as possible: — 1) the chemical changes proteins undergo when acted upon by bacteria; 2) the cause of partial ammonification of protein substances; 3) the nature of the reactions in general.

The proteins used were blood fibrin, egg albumin and peptone; the bacteria: *Bacillus subtilis*, *B. mycoides* and *B. vulgaris*. The results obtained show that: —

- 1) All the nitrogen forms are more or less changed by the action of the bacteria and the end-product ammonia is formed. In no case was any form of nitrogen completely destroyed.
- 2) The rapidity of action varies greatly with different protein substances; casein showed no further change after a few days, whereas gliadin continued to ammonify after 30 days.
- 3) One organism does not act alike upon different proteins. The relative proteolytic activities of the organisms used depend on the protein acted upon.
- 4) The monoamino-acid nitrogen and diamino-acid nitrogen of the protein are the chief sources of the ammonia formed by bacterial action.
- 5) The similarity of chemical change between the action of acid hydrolysis and that of bacteria indicates that the latter is largely hydrolytic to the point of formation of various amino-acids.
- 6) No toxic substance that would inhibit complete ammonification of a protein is formed.

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- 261 - **Irrigation of Orchards in U. S. A.** — FORTIER, SAMUEL, in *U. S. Department of Agriculture, Farmers' Bulletin No. 882*, pp. 49, 30 figs., illustrations. Washington, D. C., October, 1917.

This bulletin is a revised edition of that on the irrigation of orchards in the west of the United States, published in 1910.

In the arid and semi-arid districts of the United States the irrigation methods vary with the water supply, climate, soil and situation of the orchard. The cost of installing and maintaining a system varied greatly. The value of water for irrigation has greatly increased of recent years, and in many districts there is a scarcity of water at certain times. For these reasons many orchard-owners have installed pumps to raise underground water. In 1914 there were in California alone 24 600 plants for raising water for irrigation purposes. In other parts of the West reservoirs are being

supplement the insufficient flow in late summer. The canals, previously open ditches in earth, have been improved and lined with concrete, in many cases, replaced by underground pipes to prevent loss of water. The water is often supplied by companies, who have also greatly improved the distribution of their water.

The trees are planted in lines, squares or hexagons. The most common method of irrigation is by furrows between the rows of fruit-trees. These furrows vary in depth, length and distance apart according to the surface, quantity of water to be used, etc. The head ditches and those distributing the water in the furrows may be built in various ways, some being very expensive and only justifiable for large orchards. The bulletin describes the most common types of head flumes, which may be of wood, cement or concrete. The number of furrows between the rows of trees varies with the space between the rows, the age of the trees, the depth of the furrow and the character of the soil. Deep ditches are usually preferred, the most common depth being 8 inches. The grade of the furrows varies; in ordinary soils it does not exceed 3 to 4 inches per 100 feet. The machine generally used for tracing furrows in citrus orchards consists of a heavy frame to which are attached two or three double moldboard ploughs; a 2 to 14 inch corn lister is also used for deeper furrows. The length of the ditches varies from 300 to 600 feet. The time required to irrigate depends on the quantity of water used, the length of the furrow and the nature of the soil.

The orchards are also sometimes irrigated by the basin method by digging, midway between the rows of trees, ridges at right angles to each other. By this method the land is divided into squares with a tree in the centre of each; more rarely each square contains four or more trees. This method has recently been renewed in California because, while thoroughly loosening the soil, it allows the growing of alfalfa and other leguminous plants, to the great advantage of the orchard.

Many orchard owners base the interval between two irrigations on examination of the vegetation; they renew the stream when the trees show visible signs of suffering, *i. e.* when their leaves begin to change colour and curl. This method is not practical and it is the moisture content of the soil which should be considered. In the state of Washington there are three or four waterings at intervals of 20 to 30 days, the first being given in April or early in May. In Idaho there are three irrigations, beginning about June 15. In Montana the orchards are irrigated towards July 15, August 10 and August 20. In southern California the citrus trees are watered six or seven times during the summer at regular intervals.

The bulletin also deals with loss by evaporation and percolation, and with drainage which, under certain conditions is frequently necessary.

Irrigation with Pumped Water in Montana, U. S. A. — See No. 336 of this Review.

- 263 - **The Influence of Fineness of Division of Pulverised Limestone on Crop Yield as well as the Chemical and Bacteriological Factors in Soil Fertility.** — KOPELSON, N., in *Soil Science*, Vol. IV, No. 1, pp. 19-67 + 2 figs., bibliography of 124 publications. Baltimore, July, 1917.

After discussing in detail the work published on the liming of soils the author gives the results of his experiments made on various soils with pulverised limestone passed through sieves of 20-40, 60-80, 100-200 and more than 200 mesh. These experiments were compared with control plots with burnt lime.

An increase in the fineness of the lime gave a proportionate increase in the yield and nitrogen content of crimson clover. The finer the lime the more rapid was the neutralisation of the acidity of the soil and the greater the bacterial processes of ammonification, nitrification and nitrogen fixation. In the case of barley, buckwheat and rape, fine limestone without nitrogen gave yields equal to those obtained with coarse limestone with an application of 660 lbs. of ammonium sulphate per acre. Limestone passed through a 200 mesh sieve may be considered as efficient as burnt lime. An increase in the fineness of the limestone decreases the lime-requirement of the soil, but the drainage waters show a small loss of ammonia and nitric nitrogen, but an increased loss of calcium.

- 264 - **Fermentation of Manure Treated with Sulphur and Sulphates: Changes in Nitrogen and Phosphorus Content.** — AMES, J. W. and RICHMOND, T. E. (Ohio Agricultural Experiment Station), in *Soil Science*, Vol. IV, No. 1, pp. 79-89, bibliography of 21 publications. Baltimore, July, 1917.

It is known that the addition of acid phosphate to manure helps to preserve the nitrogen, and the treatment of manure with gypsum is also a common practice. Recently, however, LIPMAN and his co-workers have called attention to the beneficial effect of treating compost heaps with sulphur and the by-products of mineral phosphates ("floats") which supply available phosphorus (1). To study the influence of sulphur and other materials on the fertilising value of manure as measured by its composition and effects on crops, the authors carried out experiments with solid horse manure and cow's urine treated and untreated with sulphur, calcium sulphate and acid phosphate. The manure was left to ferment in large containers and applied to small plots. The nitrogen, phosphorus, sulphur and organic matter in the manure were then determined.

After 250 days' fermentation the loss of dry matter in horse manure mixed with a litter of fine cut straw was: — 32.5 % when untreated, 21 % when treated with 342 grams of acid phosphate or 497 grams of calcium sulphate per 30 lbs. manure, and 18.2 % when treated with 100 g of flowers of sulphur per 30 lbs. of manure. Manure treated with acid phosphate, calcium sulphate and sulphur only lost about 3.5 % of its

(1) LIPMAN, J. G., McLEAN, H. C. and LINT, H. C., The Oxidation of Sulphur in a Means of Increasing the Availability of Mineral Phosphates. *Soil Science*, Vol. I, pp. 533-539, 1916. In: *Sulphur Oxidation in Soils and its Effect on the Availability of Phosphates*. *Ibid.*, Vol. II, No. 6, pp. 499-538. (Ed.)

trogen, whereas the loss in untreated manure was 10.5 %. Both the water-soluble and the citrate-insoluble phosphorus was decreased in every case. During fermentation manure treated with sulphur increased in acidity, whereas the untreated sample became alkaline.

Sulphur, calcium sulphate and acid phosphate were all very effective in preventing loss of nitrogen from urine. In 5 weeks the untreated urine lost 80 % of its nitrogen, that treated with 7 grams of sulphur per 500 cc. lost 10 %, that treated with 27 grams of calcium sulphate per 500 cc. lost 72 % and that treated with 27 grams of acid phosphate per 500 cc. lost 7 %.

Sulphur also prevented the formation of ammonium salts, whereas with calcium sulphate 68 % of the total nitrogen was transformed into ammonium sulphate. In urine treated with acid phosphate and kept in an open jar for 27 days no ammoniacal nitrogen was formed, but after being kept 3 months in a closed jar it turned alkaline and evolved ammonia.

65 - Garbage Tankage, its Composition ; The Availability of its Nitrogen and its Use as a Fertiliser. — SCHROEDER, P. J. (Bureau of Soils, U. S. Department of Agriculture), in *The Journal of Industrial and Engineering Chemistry*, Vol. IX, No. 5, pp. 513-518. Easton, Pa., May, 1917.

In about half of the towns of the United States garbage is treated by 99 companies and municipalities for the extraction of fat; the residue, called "tankage" is considered as a low grade fertiliser. In 1914, 1 200 000 tons of garbage were dealt with yielding, besides the fat, 173 000 tons or 15 % of tankage, valued at \$ 1 157 000 at pre-war prices, but now worth almost twice as much. If the garbage of all towns with a population of more than 30 000 were so dealt with, the production of degreased garbage would exceed 345 000 tons and be worth over 4 million dollars.

In some cases the bits of glass, tin, etc. are first eliminated from the garbage; it is then treated by one of the following methods: —

- 1) Cooking under pressure with steam (tanking); elimination, as complete as possible by pressing, of water and fats liberated, from which the oil is separated by settling and skimming; extraction with gasoline of the grease remaining in the solid residue after it has been dried.
- 2) Crushing to render the particles uniform in size; drying, followed by extraction with gasoline; grinding of the solids for tankage.
- 3) Heating with boiling gasoline to evaporate the water and extract the fat.

In some plants where the first process is used the dried tankage is not extracted with gasoline for the recovery of the fat; in others the aqueous solution is evaporated to a sticky consistency and mixed with the degreased tankage which is then re-dried.

In appearance garbage tankage is a coarse, brown powder, either granular or finely fibrous; it generally contains bits of bone, crockery or glass in proportions varying with the degree of care with which the sorting has been carried out. The appended table gives the average chemical composition of 75 samples of raw garbage and 20 samples of tankage from various plants; the fat was not extracted from four of these last samples.

MANURES AND MANURING

Average composition of treated and untreated garbage.

	Moisture	Ash	Ether extract	Potash	Nitrogen	Phosphoric acid	Combustible matter
Raw garbage	73.75%	3.66%	3.32%	0.27%	0.70%	0.43%	22.63%
Tankage	3.67*	29.15*	4.92*	0.80*	2.78*	3.56*	

* Percentages calculated on moisture free basis.

Attempts have recently been made to use tankage as cattle food by employing flotation methods to remove the hard matter. It is, however, largely used as fertiliser material, to which, by its composition, it is well suited. It has only been used successfully as a low grade fertiliser and its high organic content makes it of increased value for soils poor in humus.

Tankage is sold at a relatively low price because of the general opinion that its nitrogen is of a limited fertilising value. The author's investigations show this opinion to be erroneous; estimations by the alkaline permanganate method showed 40 % and more of assimilable nitrogen as compared to 57 % in cottonseed meal, and nitrification tests gave equally good results. About $\frac{1}{4}$ of the total nitrogen of garbage is soluble in water, and this proportion may be increased considerably by treatment with sulphuric acid.

Seeing that other high-grade organic nitrogen fertilisers, such as cottonseed meal and slaughter-house residues, are being used more and more as food for stock, and that garbage tankage contains a large amount of nitrogen, garbage tankage should be more generally used as a fertiliser, thus permitting not only of a more complete utilisation of the garbage, but also of increased municipal profits.

266 - **Effect of Three Annual Applications of Boron on Wheat** (1). — COOK, F. C. and WILSON, J. B. (Bureau of Chemistry, U. S. Department of Agriculture), in the *Journal of Agricultural Research*, Vol. X, No. 12, pp. 591-597, bibliography of 6 publications. Washington, September 17, 1917.

In the experiments described, horse manure, containing sufficient borax to kill fly larvae, was used as fertiliser on plots on which wheat was grown during three successive years to determine whether boron used as larvicide is detrimental to wheat. At the same time another plot was treated with manure containing colemanite (a borate of lime). There was also one plot used as manured control and another used as unmanured control. The borax was applied at the rate of 154 lbs. of boric acid per acre (a quantity sufficient to kill the larvae) during the first year, and at the rate of 38.5 lbs. per acre during the two subsequent years. The colemanite, a less efficient larvicide, was applied at the rate of 50.75 lbs. of boric acid per acre each year.

In the case of large applications of borax during the first year a considerable yellowing of the young wheat plants was noticed and, as compared with

(1) See *R. Aug.*, 1916, No. 854. (Ed.)

manured control plot, a reduction of 10 % in the yield during the first years, whereas the effect of colemanite was hardly noticeable. In last year all the yields were low except that of the borax-treated plot, which was relatively high.

The wheat absorbed only minute amounts of boron (slightly more, however, from the borax), and the distribution of the boron was relatively even in the straw and the grain.

The presence of soluble boron was found in the soil after a heavy application of borax, but not in the other cases. The boron apparently is usually combined in an insoluble compound and so distributed that the first 6 inches of soil show little total boron after three yearly additions of it. There is no evidence of any cumulative action of boron in the soil; apparently the soluble boron, not the total boron, in the soil which reaches wheat plants.

- Occurrence of Manganese in Insect Flower Stems. — MC. DONNELL, C. C. and ROARK, R. C. (Insecticide and Fungicide Laboratory, Miscellaneous Division, Bureau of Chemistry, U. S. Department of Agriculture), in the *Journal of Agricultural Research*, Vol. XI, No. 3, pp. 77-82, bibliography of 16 publications. Washington, October 15, 1917.

To detect the adulteration of pyrethrum insect powder (*Chrysanthemum cinerariaefolium* Vis.) UNGER (1) recommended testing it for presence of manganese, which is absent in pyrethrum stems. This statement has been contradicted by other workers. The authors carried out tentative determinations of the manganese content of the stems and open and closed flowers of pyrethrum of both Dalmatian and Japanese origin.

The analyses showed the manganese content of both stems and flowers vary considerably, and the difference between the two parts of the plant is so small that the determination of the manganese content as a control for the amount of stem in an insect powder would be useless. Moreover, pyrethrum from Japan contains more manganese than that from other countries, owing, presumably to the high manganese content of the volcanic soils of Japan. An increase in the manganese content of pyrethrum is accompanied by a slightly higher nitrogen and phosphoric acid content.

- The Proteins of the Peanut, *Arachis hypogaea*: The Distribution of the Basic Nitrogen in the Globulins Arachin and Conarachin. — JOHNS, CARL O. and JONES, D. BRESE, in *The Journal of Biological Chemistry*, Vol. XXX, No. 1, pp. 33-38. Baltimore, May, 1917.

In a recent paper (2) the authors showed that the globulins of the peanut contain a relatively high percentage of basic nitrogen; arachin, the chief protein of the peanut, contains 4.96 %, and conarachin 6.55 %. These values were obtained by the Hausmann method, in which no correction is made for the solubility of the phosphotungstates of the bases, and are therefore, lower than those obtained by the Van Slyke method, in

(1) UNGER, H., Flores Chrysanthemi, *Pharm. Ztg.* XXXII, 96, 685-686, 1887. — ID. XXXIII, 23, 166-167; 1888. — (2) See R. Feb., 1917, No. 128, (F.D.).

which this correction is made. The authors, therefore, analysed these globulins by the Van Slyke method and found both to contain arginine, histidine, lysine and cystine in the following proportions:

Percentage of Basic Amino-acids in the Globulins of the Peanut

	Arachin	Conarachin
Arginine	13.41	14.60
Histidine	1.88	1.83
Lysine	4.98	6.04
Cystine	0.85	1.07

The figures for cystine are undoubtedly too low as they represent only the cystine which escaped destruction during the hydrolysis of the proteins with hydrochloric acid.

The two globulins also give a marked reaction to tryptophane. Considering the high proportion of lysine in the proteins of the peanut and peanut meal (which contains about 28 % of protein [$N \times 6.25$] when made from whole nuts, and 45 % when made from shelled nuts), both might be advantageously used to supplement diets deficient in lysine. (1) For example, gliadin, the protein of wheat, only contains 1.21 % of lysine; zein, the protein of maize, contains none at all. On the other hand, legumin of the pea and phaseolin of the kidney bean are relatively rich in lysine, containing 4.29 and 4.58 % respectively.

269 - Sedoheptose, a New Sugar from *Sedum spectabile*. — L. A. FORGE, F. R. & HUDSON, C. S., in *The Journal of Biological Chemistry*, Vol. XXX, No. 1, pp. 617, Baltimore, May, 1917.

The aqueous extract of the leaves and stems of *Sedum spectabile* contains a non-fermentable, reducing sugar. Analyses of its crystalline phenyl and bromo-phenyl osazones show it to be a new heptose which the authors call sedoheptose. By reduction of a solution of the sugar with sodium amalgam, two heptahydroxy alcohols, designated as α and β sedoheptitol were obtained. In all probability sedoheptose is a ketose, as bromine does not oxidise it and the two above-mentioned alcohols probably result from reduction.

270 - Influence of Hydrogen-Ion Concentration of Medium on the Reproduction of Alfalfa Bacteria. — FRED, E. B. and LOOMIS, N. E. (Department of Bacteriology, University of Wisconsin), in the *Journal of Bacteriology*, Vol. II, No. 6, pp. 629, 1 diagram, bibliography of 7 publications. Baltimore-London, November, 1917.

MICHAELIS, CLARK and others have shown the hydrogen-ion concentration of the medium to have a great influence on its reaction and the bacteria.

(1) OSBORNE and MENDEL (*Journal of Biological Chemistry*, Vol. XVII, p. 325, 1915) and other workers have shown that lysine is essential to the growth of animals. Nutritional experiments (HOPKINS, F. G., *Journal of the Chemical Society*, Vol. CIX, p. 629, 1916) have shown that the animal organism cannot synthesize lysine which must, therefore, be supplied in food in sufficient quantity to ensure normal growth.

OSBORNE and JONES (*American Journal of Physiology*, Vol. XXIV, p. 438, 1909) found following different percentages of lysine in the muscle substance of different animals: — *Salmo (Ictalurus nebulosus)*, 5.77 %; halibut (*Hippoglossus vulgaris*), 7.45 %; chicken, 7.21 %; 7.59 %. See also *B.*, Jan., 1915, No. 72. (Ed.).

processes. Certain species are very sensitive to slight changes, whereas others develop in a medium having considerable variation in reaction. The author studied the effect of this reaction on the growth of *B. radiculicola* on alfalfa.

As culture medium was used a mannitol solution composed of mannitol gm., magnesium sulphate 0.2 gm., monobasic potassium phosphate 0.2 gm., sodium chloride 0.2 gm., calcium sulphate 0.1 gm., distilled water 100 cc. This solution was divided into 24 parts of 100 cc. each, and the reaction changed by the addition of N/10 sulphuric acid or sodium hydroxide. The hydrogen-ion concentration was determined immediately after inoculation and again two weeks later. The results, given in tables and graphs, show that the change in hydrogen-ion concentration is much greater with a given increase in acidity than for a corresponding increase in alkalinity, especially after bacterial growth has continued for two weeks. There is a correlation between "hydrogen-ion concentration" and "growth of *B. radiculicola* on alfalfa". This bacterium is much more sensitive to sulphuric acid in mannitol solution than to gram equivalent amounts of sodium hydroxide. The results confirm those of PRUCHA (*New York Agricultural Experiment Station, Cornell, Memoir 5*, pp. 41-47, 1915), who found that normal hydrochloric acid is much more injurious to the multiplication of *B. radiculicola* on alfalfa than equivalent amounts of normal sodium hydroxide. The apparent resistance of legume bacteria to alkalis seems to be due to the slight concentration of hydroxyl-ions in the mannitol solution. The highest count was obtained in a neutral solution; small amounts of alkali had very little effect on the number of bacteria. On the other hand, acid in gram equivalent amounts seriously retarded or inhibited growth. The relation of "growth" to "hydrogen-ion concentration" remained almost the same after two and four weeks.

The curves representing the hydrogen-ion concentration of mannitol solution before and after the growth of *B. radiculicola* show clearly that the concentration changes under the effect of the growth of the bacteria, which, apparently, bring about changes in the reaction of the medium favourable to their reproduction.

- Influence of Position of Grain in the Cob on the Growth of Maize Seedlings.

- HALLSTED, BYRON D. and OWEN, EARLE J., in the *Journal of the American Society of Agronomy*, Vol. IX, No. 6, pp. 267-275. Washington, D. C., September 25, 1917.

The experiments were made at the New Jersey Agricultural Station with 5 ears of each of 20 representative varieties and crosses of maize. The tips from each ear were divided into 10 equal lots, each representing a zone of the ear, ranging from the butt to the tip. The average weight of the grains in each zone of 2 of the 5 ears was determined, and 25 kernels from each lot were sown 1 inch deep in a greenhouse bed. In the butt and the tip zones the smallest perfect kernels were chosen; in the others they were taken at random. The plants were harvested 17 days after sowing.

The emergence of the tips of the seedlings was recorded daily and the averages calculated from it. At harvest time the viability, weight and

length of the seedlings were recorded, and the vigour and variability deduced from them. By averaging the 5 units in each set, a series of tables were obtained showing the relationship of the position upon the cob to the following particular characters under consideration: 1) weight of grain; 2) specific gravity of grain; 3) emergence of seedlings; 4) viability of seedlings; 5) weight of seedlings; 6) length of seedlings; 7) variability in length. Table I gives information concerning the average weight of the grain, Table II the order of the 7 characters considered; No. 1 represents the minimum, No. 10, the maximum value of the averages.

TABLE I. — *Average weight (in centigrams) of grains of 20 varieties of corn in each of 10 zones from the butt to the tip of the ear.*

Varieties	Zone									
	Butt									Tip
	1	2	3	4	5	6	7	8	9	10
Longfellow	43	44	43	42	42	40	39	37	35	31 H
Hickory King	52	55	56	53	53	51	48	46	46	42 H
Golden Queen (ripe)	16	17	16	16	15	12	13	13	12	10 H
Golden Queen (unripe) . . .	6	6	7	7	7	7	6	5	4	3 L
Champion White Pearl . . .	40	39	38	37	37	35	35	34	33	29 H
Reid Yellow Dent	29	29	28	28	27	26	24	22	20	17 H
Iowa Silvermine	32	32	32	31	31	29	28	27	27	24 H
Boone County White	40	38	38	37	35	34	33	32	31	28 H
King 100-Day	40	38	36	36	36	36	36	34	33	28 H
Early Learning	34	35	35	34	32	32	32	31	31	29 H
Brazilian Flour	30	31	31	31	31	30	29	28	27	24 H
Stowell Evergreen	30	28	27	26	26	25	25	24	23	21 H
Black Mexican	28	30	29	29	29	28	27	26	23	20 H
Country Gentleman	18	15	15	14	14	13	13	14	12	11 H
Golden Bantam	26	27	27	27	26	26	24	23	21	18 H
Crosby Early	25	25	24	23	23	22	20	20	18	17 H
Golden Queen × Hickory King	26	28	29	28	28	27	27	25	23	18 H
Squaw × Country Gentleman	25	25	25	24	24	23	23	22	22	18 H
Golden Queen × Champion White Pearl	27	27	26	27	26	25	24	22	20	18 H
Golden Queen × Brazilian Flour	24	24	24	23	23	22	21	21	20	18 H
Total	591	593	586	575	565	545	530	508	481	434
Average	29.6	29.7	29.4	28.8	28.3	27.2	26.5	25.4	24.1	21.8

Thus, for the general average, with the exception of the butt zone, the weight of the grain decreases from the butt to the tip.

TABLE II. — Order of the averages for the characters studied.

Character	Zone									
	1	2	3	4	5	6	7	8	9	10
Height of grain	9	10	8	7	6	5	4	3	2	1
Specific gravity	4	5	7	8	9	10	6	3	2	1
Emergence	1	10	9	8	6	7	5	2	4	3
Viability	1	3	4	10	7	9	6	8	5	2
Vigour	2	9	8	10	7	6	5	4	3	1
Length	2	3	9	10	8	7	6	5	4	1
Variability	10	8	3	5	4	2	6	1	7	9

The *specific gravity* ranges from 1.35 in Golden Queen to 1.16 in Brazilian Flour. The sweet corns have a high specific gravity, due to their low starch and high sugar content and the horny texture of their endosperm. The cross between the two above-mentioned varieties has a specific gravity most exactly intermediate to the two extremes — 1.26; the other two crosses are also near the mother plant. In a general way the specific gravity decreases in both directions rather regularly from the middle of the ear. If 5 groups are made from base to tip, the totals of the ranking figures are 9, 15, 19, 9, 3. This shows that the decrease is much more rapid in the upper than in the lower half of the ear. If only 3 groups are made, namely, the basal three, the middle three, and the 4 upper zones, the averages of the specific gravities are 1.25, 1.26 and 1.24.

As regards *rapidity of germination* (time between sowing and emergence of the tip), the average for all zones is somewhat less than one week (6.44 days). The butt zone emerged the quickest (a little over 6 days), while the zone just above it took 10 hours longer and was the slowest of all the zones. There is a fairly uniform decrease in time for emergence from the 2nd. to the 10th. zone. This is in correlation with the specific weight, i. e. the lighter the grain the more rapid is emergence.

The general average of the *viability* of the grain was 91.91 %, although the unripe ears of Golden Queen only gave 67.87 %. Brazilian Flour 69.94 % and Stowell Evergreen a little more. As has been always observed in previous studies sweet maize, as a group, has the lowest viability. The maximum viability is found in the 4th. zone (94.44 %); the minimum in the basal one (87.68 %), which is closely followed by the tip. The five best zones are the central one and the two contiguous to it on either side. Whereas the heaviest grains are in the lower half of the ear, those of greater density and viability are in the middle zones.

The *vigour* is expressed by the live weight of the plant minus the weight of the grain from which it sprung. For the whole ear the averages of the 10 varieties or crosses tested (see Table I) were (in grams): — 2.277, 3.050, .082, 0.356, 2.744, 1.339, 2.374, 2.134, 2.105, 1.911, 1.155, 2.447, 1.098, .832, 2.326, 2.198, 1.777, 1.898, 2.272, 1.928; the averages for all the varieties and crosses for each of the 10 zones are: — 1.893, 2.125, 2.116,

2.133, 2.094, 2.064, 2.010, 1.966, 1.896, 1.503; the general average for all the varieties and crosses and for all the zones was 1.980. These results show that, as regards vigour, the best grains are those in the lower half of the ear, with the exclusion of those at the butt, which are very weak. The upper zone shows a uniform decrease in vigour from the 6th. zone to the tip.

There is a strong positive correlation between viability and vigour; the most viable seeds are the most vigorous, and the same naturally applies to the length of the seedling.

Variability is evidently correlated with weakness, but to determine to what degree, measurement of more than 2 500 seedlings must be taken. In other words, viability and vigour are negatively correlated with variability. A set of strong plants is more uniform than one of weak seedlings. Variability is greatly influenced by position on the cob; this may be due to size as well as to maturity and nourishment of the grains.

A practical application of these results would consist in germinating a large sample, say 20 grains, from two rows upon opposite sides near the middle of the ear, selecting ears showing practically 100 % viability, and planting only grains from the middle of the ear, rejecting those from the butt zone and the four upper zones. This would be a more rigorous method than that, now in use, of discarding a few of the grains from the butt at tip of the ear.

272 - **Graft Hybrids Observed on Olive and Maple Trees in Italy.** — *L'Italia agricola*, Year LV, No. 1, p. 17 + 1 coloured plate. Piacenza, January 15, 1918.

The coloured plate shows a Cannellino olive tree with white fruit which when grafted on a Caiazzana olive tree with black fruit, produced white and black olives.

A variegated maple is also reported which, when grafted on a green maple, bore a branch having all the characters of the green maple and none of those of the variegated maple (1).

273 - **The Luleå Branch of the Svalöf Station, North Sweden.** — TEDIN, HANS, in *Svensk Utsädesförenings Tidskrift*, Year XXVII, Pt. 5, pp. 223-232. Malmö, 1917.

Svalöf and Luleå are separated by more than 10 degrees of latitude, and the physiographical conditions of each differ widely (2), especially where:

(1) For other graft hybrids reported in Italy, see *B. Sept.*, 1915, No. 928. (Ed.)

(2) The following facts show the differences between the climatic conditions of the Svalöf and the north (Luleå) of Sweden. It is the custom, which, moreover, corresponds fairly well to reality, to call, in these districts, "summer" the period when the average temperature is above 10° C, "winter" the period when it is below 0° C, and "autumn" "spring", the two intermediate periods. Taking this distribution as a basis, in north Sweden, summer barely lasts two months, till the middle of August, whereas, in south Sweden, it begins in the middle of May and lasts to the middle of October, *i.e.*, four months in all. The contrast between north and south is still more marked as regards the growth of cultivated plants if the part of the year free from frosts is considered; at Karesuando (North Sweden) the last spring frost occurs, on an average, on June 15, and the first autumn frost on August 15, so that the frost-free period hardly lasts 72 days; at Stockholm, on the contrary, there are 180 months without any frost and, in the Island of Ven (Öresund), 6 months. (GUNSCH, *Schweden*, Vol. I, pp. 43-44, Stockholm, 1913).

growth of cultivated plants is concerned. The aim of the selector is to unite in one variety the characters "intrinsic yield" and "resistance to the most unfavourable meteorological phenomena" in a given locality. As the intensity and distribution of the meteorological phenomena at Svalöf and Luleå differ, it follows that varieties selected at Svalöf do not stand the same chance of success when introduced into Norrland. Experiments on this subject gave absolutely negative results and it was, therefore, decided to form a special centre of selection for the north of Sweden — the Luleå branch Station.

EARLINESS. — All crops, especially cereals, in proportion as they grow further south, have a shorter period of growth which allows the plant to attain and exceed the ripening stage during the short summer. What degree of earliness is required for the conditions found in Norrland? It was thought possible to solve this question by using in selection varieties from the northern districts, but it was soon seen that the place of origin is no guarantee of success. Thus, for example, among the barleys grown in the Norrland area early and late varieties. As a whole these varieties answer fairly well to the average climatic conditions and annual variations, but, when separated and grown in pure lines, they may give negative results. The variety No. 01243, a six-rowed barley, isolated at Svalöf from material sent from Luleå, when introduced into Norrland, proved late, ripening about a week after the local types. Nos. 01201 and 01222, six-rowed barleys from Dalarne (central Sweden), on the contrary, proved Norrland, as early as the northern types. This may be explained by the fact that every variety transported from one district to another shows a tendency to adapt itself to the new conditions by developing the necessary characters. In southern Sweden the earliest forms of a given type tend to decrease their degree of earliness, or to make it disappear altogether, whereas it is very difficult to show very small differences, of two days for example, differences which, in the north, corresponding to the limits of distribution, are of special importance, for two days more or less for a certain variety may make all the difference between ripening and not ripening. What has been said for earliness also applies to resistance to cold and diseases.

CHARACTERS OF THE STRAW. — In Norrland growth is even more rapid and regular than in the southern districts; the barley No. 01201 which, at Svalöf, has a short stem, when sown in the north has a much longer stem, and is subject to lodging. This modification, however, is not equal and proportionate for all varieties. Thus, for example, Findelen No. 0161 and 0164 (from plants gathered by the author at Findelen, near Zermatt, Switzerland, at an altitude of about 6800 feet) developed culms of equal length both at Svalöf and at Luleå (length of culm about 2 feet). In order to pass a just opinion on the character of the straw, experiments must be carried out in the district to which the variety is destined.

GRAIN YIELD. — The earliness, structure of the culm, resistance to cold and disease, which, as has been seen, vary with the environmental conditions, have a marked influence on the yield, so that even the charac-

ter "productivity" changes in different places. Earliness does not suffice to guarantee the strength of the yield at higher latitudes. A striking example of this is given by the very early six-rowed barley, Svalöf No. 01201. During the years 1894-1904 this barley gave an average of 19.11 cwt. per acre, a yield much below that of the Chevalier variety, 23.57 cwt. per acre. This may be explained by excessive earliness (in the south at least) accompanied almost always by decreased productivity. If, however, 19.11 cwt. are not much at Svalöf, they represent a fairly good harvest in Norrland. Attempts have been made to introduce the barley 01210 in Norrland, but although it was sufficiently early, the results as regards yield of grain were far from encouraging.

The attempts to introduce into the northern districts types selected at Svalöf go back to 1904, the year in which a series of comparative tests with 37 varieties of barley, 21 six-rowed and 16 two-rowed, was carried out in Luleå.

As regards two-rowed barleys, repeated attempts made even with very early varieties, such as 0116 from Westergötland, 0161 and 0164 from Findelen (Switzerland), were all completely negative. On the other hand among the numerous varieties of six-rowed barley studied repeated tests distinguished 01209, 01222 and 01225, fairly early and good producers. 01209 at least, also having a large, well-formed caryopsis. The variety 01206 from Dalarne deserves special mention. AXEL ULANDER states that in 1908 this variety was still earlier than the very early native barleys of Joukasförvi and Pasala. In spite of these few exceptions the Svalöf varieties have gradually had to give way before those selected at Luleå natives of the Norrbotten coast, or the province of Torneå, or else collected from the Luleå district.

274 - **Experiments in Field Technic in Row Tests.** - HAYES, H. K. and ARMY, A. C. in the *Journal of Agricultural Research*, Vol. XI, No. 9, pp. 399-419. Washington, November 26, 1917.

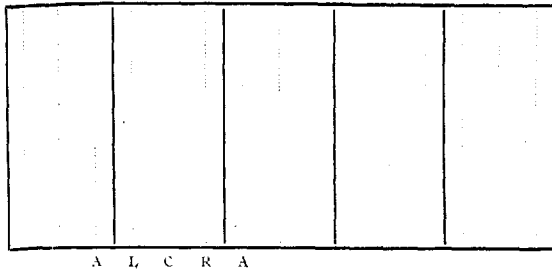
The lack of uniformity in selection methods sometimes makes it difficult to compare the results obtained by different workers. While the nature of the investigations excludes the use of exact rules, as in chemistry and physics, it is, nevertheless, possible to standardise the methods so as to decrease errors in the estimation of biometrical data.

Where cereals are concerned, the size and shape of the plots, the competition between them or their reciprocal action, soil heterogeneity, and all factors which have a considerable influence on the yield, and make it difficult to estimate, because many of the figures are not strictly comparable. The authors have attempted to find a method to reduce these sources of error to a minimum by a series of field experiments with barley, oats and wheat, which aimed at determining: -

- 1) The effects of competition between adjacent rows of cereals of the same and of different varieties.
- 2) The planning (length, spacing, number of rows) which will most effectively reduce to a minimum the effects of competition.

3) The number of times an experiment must be repeated to eliminate errors due to heterogeneity of soil.

Each of the experimental plots, adjacent one to the other, contained 18-foot rows of cereals. The rows were 1 foot apart. In other words there were two border rows, one at the left (L), the other at the right (R), and a centre row (C). This arrangement is shown for one plot in the following figure, which also includes the adjacent rows (A) of the two plots on either hand.



A. — EFFECT OF THE HEIGHT OF THE ADJACENT LINES ON THE YIELD OF THE BORDER LINES OF ANOTHER VARIETY OF THE SAME SPECIES. — There was one plot for each variety, arranged as described above. At harvest time 1 foot was discarded from each row, reducing the length considered to 16 feet.

To compare the *yield in grain* the following method was adopted; — if the left (L) border row yielded more than the right (R) border row, the result was considered *positive* and the difference expressed in + bushels per acre; if the right border yielded the most the result was considered *negative*, and the difference expressed in - bushels per acre.

The height of rows adjacent to the border rows of another plot were compared in the same way. If the variety near the left border was higher than the variety near the right border, the result was *positive*, expressed in + inches and centimetres; in the opposite case the result was *negative*, expressed in - inches and centimetres.

With the results obtained tables were drawn up showing the correlation between *difference in yield* and *difference in height*, such as the following (see p. 306), concerning barley.

The figures given in this table made it possible to calculate (by WENFORD'S formula) a very high negative coefficient of correlation: $r = -0.519 \pm 0.065$. The height of the rows of barley adjacent to the border rows of a neighbouring plot thus has a decided influence on the yield in grain of these border rows; the greater this height the lower the yield.

The same applies to winter wheat, where $r = -0.337 \pm 0.097$.

There is, however, but a very slight negative correlation or even a slightly positive relation in oats and spring wheat.

Correlation between the difference in yield between the border rows of one variety and the difference in height of adjacent lines of other varieties.

Difference in yield of a border rows of the same variety (bushels per acre)

	-9	-7.5	-6	-4.5	-3	-1.5	0	+1.5	+3	+4.5	+6	+7.5	+9	
-25							1			1				1
-20							1		1			1		1
-15								1		1		1		1
-10					*	1		1	2	1		1		1
-5					1	1	1	1	2	1			1	1
0			1	1	2	1	3		3	2				1
+5	2				2	3		1	1	1				1
+10	1	1					1							1
+15						1			1					1
+20					1			1						1
+25					1									1
+30				1	1									1
	3	1	2	3	8	7	7	5	10	7	0	3	1	1

The figures in the squares within the border represent the number of varieties showing such or such a combination between difference in yield and difference in height. The total of these figures for each class are given outside the border on the right and at the bottom and give a total of 57 varieties, shown in the right-hand bottom corner.

B. -- EFFECTS OF THE ADJACENT LINES ON THE YIELD OF THE BORDER ROWS OF A DIFFERENT VARIETY OF THE SAME SPECIES. — These effects were determined as in the preceding case. The results show them to be less than the effects produced by the height of adjacent lines. The negative coefficient of correlation was again highest for barley — $r = -0.394 \pm 0.07$, about 6 times the probable error, followed by that of spring wheat — $r = -0.290 \pm 0.087$. The other cereals had very low positive correlations, except in the case of winter wheat, where $r = +0.315 \pm 0.09$. These positive coefficients might be due to soil heterogeneity.

C. — VARIABILITY OF BORDER ROWS, CENTRE ROWS AND THREE-ROW PLOTS OF CONTROL PLOTS. — The cereals studied are Haynes Bluestem wheat, Turkey winter wheat, Ligowa oats and Manchuria barley. The border rows were found to vary much more than the centre rows, as the following figures, collected at the Minnesota Plant Breeding Nursery and Farm Crops Section, show,

Cereal	Experiment field	Difference between coefficient of variability of border and central rows
Haynes Bluestem wheat	Plant Breeding Nursery	2.90 ± 1.788
	Farm Crops variety test	1.35 ± 1.390
Turkey winter wheat	Plant Breeding Nursery	2.74 ± 1.509
	Farm Crops variety test	0.94 ± 1.838
Ligowa oats	Plant Breeding Nursery	3.93 ± 1.230
	Farm Crops variety test	2.64 ± 1.613
Manchuria barley	Plant Breeding Nursery	10.91 ± 4.208
	Farm Crops variety test	3.63 ± 1.386

The greatest differences are between barley, then between oats; they are but slight in spring and winter wheat.

On the other hand, a comparison between the coefficients of variability of yield between the centre rows and the three row control plots gave the following results: —

Oats. — Negative differences, i. e. the yield of the centre rows varies less than that of the three-row plots.

Barley. — Very slight positive differences: — 0.55 ± 2.596 and 8 ± 0.993 .

Winter and spring wheat. — Marked positive difference: — 1.65 ± 1.313 and 2.94 ± 1.699 for the first, and 0.61 ± 1.215 and 2.95 ± 1.535 for the second.

In wheat, therefore, the average yield of the three-row plots varies less than that of the centre row, but the difference is not sufficiently great to justify the extra labour which would be required to compute the yield of the two border rows apart from that of the centre row.

From the results obtained the following conclusions were deduced: —

1) There is marked competition between rows 1 foot apart. In selection work, therefore, it is best not to sow only one row per ear, but to sow three-row plots, as the two border rows have a protecting action.

2) In calculating the yield it is unnecessary to consider all the three rows, but time and work may be saved by considering the centre row only as its variability is almost equal to that of the three rows together.

REPETITION OF TESTS IN ORDER TO REDUCE THE ERRORS DUE TO SOIL HETEROGENEITY. — In the experiments described the control plots were

also used to study the efficaciousness of such repetition. Three repetitions reduced error by 25 to 50 %; 9 to 12, reduced the error to a minimum, making them almost negligible.

275 - Correlations Observed in Continuously Cropped Barley, in U. S. A. - See No. 289 of this Review.

276 - A Method for Determining the Percentage of Self-Pollination in Maize, - WALLER, A. E., in the *Journal of the American Society of Agronomy*, Vol. IX, No. 1, pp. 35-37. Lancaster, Pa., January, 1917.

In the maize endosperm which results from fusion of the second nucleus of the pollen grain with the two polar nuclei, the yellow colour is dominant to the white. If, therefore, a white variety is fertilised with the pollen of a yellow variety, the resulting ears are hybrid, certain grains having the dominant yellow colour of the male parent, in accordance with the phenomenon called "xenia" (1) by FOCHE.

The author used this phenomenon as an indicator to estimate indirectly the degree of self-fertilisation in maize, applying it as follows: - in a field of yellow corn he placed, here and there, two or three plants of white maize. At the time of tasselling two of the three plants in each hill of white maize were detasseled; the third plant served to measure the degree of self-fertilisation on the basis that the white grains would be self-pollinated, the yellow grains the result of cross-pollination (xenia).

The varieties used were Reid's Yellow Dent and Wing's Hundred-Day White, which are particularly well adapted to cross-fertilisation since they flower about the same time. Of 36 ears, an average of 5.13 % were self-pollinated, but, for the reasons given in § 3, this does not represent the percentage of self-pollination which might take place under field conditions.

It should be remembered that: -

1) It is not always easy to distinguish the white grains from the yellow grains, which may be very pale. This is perhaps due to the formation in the endosperm of only *one set of yellow determinants*, brought by the second nucleus of the pollen grain, as against that of *2 sets of white determinants* contained in the double endosperm nucleus.

2) If, instead of comparing only 2 characters of the endosperm for colour (white and yellow, that is, one pair), the author had compared 2 *pairs* of characters, concerning, for example "colour" and "sugar content", the classification of the grain would have been greatly facilitated. It is, however, difficult to obtain sweet white varieties which flower at the same time as yellow field corn, and to do so a series of plantings would be necessary.

3) In the field the percentage of self-pollination is influenced by ex

(1) When a female flower is fertilised by the pollen of another variety or species, the resulting fruit may show, in its endosperm, besides the embryo of the hybrid, also the characters belonging to the fruit of the male parent. In his work called *Die Pflanzenmischlinge*, FOCHE calls this phenomenon *xenia*. - See also BAUR, ERWIN, *Einführung in die experimentelle Vererbungslehre*, p. 243. Berlin, 1911. (Ed.)

ture, spacing of rows, the direction and strength of the wind, atmospheric moisture, so that the sources of error can only be eliminated by repeating experiments during several years.

The Relation of the Vigour of the Maize Plant to Yield. — GRANTHAM, A. E., in the *Journal of the American Society of Agronomy*, Vol. IX, No. 7, pp. 340-343. Washington, D. C., October, 1917.

The experiments described were carried out at the Delaware Agricultural Experiment Station, Newark, to ascertain the relation of the vigour of the maize plant to its yield in grain. Of two plants grown in the same block, one was much stronger and vigorous than the other. About 100 such plants were chosen and grown under identical conditions, the hills thinned, the stronger plant removed in 50 cases and the weaker one in the other cases.

The two groups were distinguished by: — a) a considerable difference in the date of tasseling (August 5-12), the weaker plants being much later than the others; b) height, measured every 8 days after thinning, from June to September 18. The extreme measurements were: — on June 25, 4.7 and 9.2 inches, and, on September 18, 98.0 and 107.3 inches respectively the weak and strong plants.

The following table gives the most important results of the experiments: —

Distribution of ears from strong plants and from weak plants.

Weight of ear, grams	Number of ears		Weight of ear, grams	Number of ears	
	Strong stalks	Weak stalks		Strong stalks	Weak stalks
0-50	0	5	300-350	11	4
50-100	0	5	350-400	8	1
100-150	2	10	400-450	2	0
150-200	4	9	450-500	3	0
200-250	7	8	500-550	1	0
250-300	8	6			
				46	48

This table shows that strong stalks produce no ears under 100 gm. in weight, whereas, of 38 weak stalks, 10 produced ears weighing less than 100 gm. More than half the ears from strong stalks weighed more than 200 gm., while $\frac{2}{3}$ of those from weak stalks weighed less than 200 gm. The strong plants are also distinguished by a higher yield in grain (221.7 gm. for strong stalks, 109.6 gm. for weak ones), the weight of the cob (47.7 and 38.8 gm.), and a lower percentage of cob (19 and 24% respectively). There is, therefore, a positive correlation between vigour and yield (1).

(1) The total weight of the plant is in direct ratio to the total weight of the caryopses (also FRUWIRTH, C., *Die Züchtung der landwirtschaftlichen Kulturpflanzen*, 2nd. Ed., d. II, p. 9, Berlin, 1909). (Ed.)

278 - Correlations between Ear Characters and Yield in Maize (1). — LOVE, H. H. and WENTZ, J. R., in the *Journal of the American Society of Agronomy*, Vol. IX No. 7, pp. 315-322. Washington, October 22, 1917.

A summary is first given of the results obtained by workers who, in selection for a given character, chose the two extremes, and sought to establish the relationship between this character and the yield (2). The author then describes his own experiments (at the Department of Plant Breeding, Cornell University, Ithaca, N. Y.) in which he chose, for each character studied, ears near the average type. The maize used was Cornell No. 12, a yellow dent variety selected from the Funk Ninety Day variety. In a table are shown the correlations obtained for all the characters in each of the 5 years during which the experiment lasted.

Below are given, in Table I, the general averages for the characters studied during the 5 years 1910-1914, and, in Table II, the mean percentage of grain in the ears of a few of the highest and lowest classes with the mean yield of these classes.

TABLE I. — General averages of the characters studied.

Ear characters correlated with yield per stalk	Average (1910-1914)
Length	cm. 21.362 \pm 0.04
Average circumference	cm. 15.278 \pm 0.02
Ration of tip to butt circumference	0.859 \pm 0.001
Average circumference of cob	cm. 9.289 \pm 0.002
Weight	cm. 273.048 \pm 0.005
Percentage of grain	% 85.252 \pm 0.003
Average weight of kernels	gm. 0.283 \pm 0.001
Number of rows	17.004 \pm 0.001
Average length of kernels	cm. 1.314 \pm 0.003
Average width of kernels	cm. 0.798 \pm 0.003
Yield per stalk	lbs. 0.727 \pm 0.001

(1) See also R. February 1918, No. 148. (Ed.)

(2) WILLIAMS, C. G. (Corn Experiments, *Ohio Agricultural Experiment Station Bulletin* 282, 1915), selected ears for the maximum and minimum extremes of the characters length of ear, shape of ear, filling of tip, indentation of kernel, weight of ear and percentage of grain. In selecting long and short ears he obtained a difference of only 1.39 bushels per acre in a 1 year average yield in favour of long ears. In selection for shape of ear, tapering ears surpassed cylindrical ears in average yield during a 9-year period by 1.65 bushels per acre. Eight years selection of bare and filled tips gave an average difference of 0.34 bushel per acre in favour of filled tips. Seven years' selection of rough and smooth dented ears gave an average difference of 1.75 bushels per acre in favour of the smooth type. Seed ears averaging 88.16% of grain gave a 6-year average yield of 64.64 bushels per acre as compared with 65.00 bushels from ears averaging 76.38% of grain.

HARTLEY, C. P. (Progress in Methods of Producing Higher Yielding Strains of Corn, U.S. Department of Agriculture Yearbook, 1909, p. 309), tabulated the yields of 4 varieties in 6 years, including 1000 ear-to-row tests. He found no relation between the characters of seed ears and yield.

TABLE II. — Mean percentages of grain in the ears in a few of the highest and lowest classes, with the mean yields of these classes.

Year	High classes		Low classes	
	Percentage of grain	Yield per stalk, pounds	Percentage of grain	Yield per stalk, pounds
1910	87.074	0.822	81.676	0.859
1911	88.563	0.624	79.375	0.677
1912	87.158	0.672	80.750	0.738
1913	88.447	0.602	80.714	0.817
1914	87.235	0.651	82.750	0.645
Average	87.596	0.692	81.853	0.753

MONTGOMERY, E. G. (Experiments with Corn, *Nebraska Agricultural Experiment Station, Bulletin* 112, 1909), during many years selected ears for the characters shape of ear, shape of kernel and size of ear. He concluded the results were slightly in favour of long ears; the size of the ear depends too much on environment to be of any importance; a medium depth of kernel is to be preferred.

PEARL, RAYMOND and SURFACE, FRANK M. (Experiments in Breeding Sweet Corn, *Maine Agricultural Experiment Station, Bulletin* 183, 1910), carried out, from 1907-1909, a large number of ear-to-row tests with sweet corn. One of their conclusions is that there is no relation between the external seed characters and yield in sweet corn.

SCOVER, H. J. (Scientific Corn Breeding, *Proceedings of the American Breeders' Association*, Vol. VII, p. 43, 1911) tested Reid Yellow Dent and Johnson County White maize for 5 years. He found that ears of these varieties with 18 and 20 rows of kernels gave better yields than those with more than 20 or less than 18 rows. Averaging the results of 4 years he found that, with Reid Yellow Dent, the best yields were obtained with kernels having small germs, and with Johnson County White, with kernels having large germs. In correlating yield with shape of kernel he found that, in both varieties, square-shouldered kernels showing a small space between the rows at the crown and tip gave the best yields.

MCCALL, A. G. and WHEELER, C. S. (Ear characters not correlated with yield in corn, *Journal of the American Society of Agronomy*, Vol. V, p. 117, 1913), of Ohio State University, calculated the correlations between a few ear characters and yield and obtained the following results:

Characters correlated with yield	Coefficients of correlation	
	Series 1	Series 2
Length of ear	0.586 ± 0.0296	0.1017 ± 0.0651
Height	0.0270 ± 0.0262	0.0666 ± 0.0056
Perimeter	0.0068 ± 0.0287	0.1803 ± 0.0636
Weight	0.0272 ± 0.0203	—

The ears used in this work had not been selected for the characters used in the correlations.

CONCLUSIONS. — 1) The characters, length, ratio of tip circumference to butt circumference, average circumference of cob, weight, average weight of kernels, number of rows of kernels and average length and width of kernels, do not show correlations significant enough to be of value in judging seed maize.

2) There is a slight negative correlation between percentage of grain in the ear and yield, implying that ears containing a low percentage of grain may yield higher than ears with a high percentage of grain.

3) The average circumference of the ear is the only character showing any significant relation to yield.

4) The external characters of the ears cannot serve as a basis for the choice of high yielding ears. The points on a show card are of no value for selecting seed ears, and apply exclusively to show purposes.

5) The only basis for selecting high-yielding seed maize is the ear to-row progeny test.

LOVE, H. H. (The Relation of Certain Ear Characters to Yield in Corn, *Proceedings of American Breeders' Association*, Vol. VII, p. 29. Washington, 1912), obtained the following correlations in experiments carried out over two years:

Ear characters correlated with yield per stalk	Minnesota No. 13		Punk Ninety Day	
	1909	1910	1909	1910
Length	-0.059 ± 0.079	0.241 ± 0.064	0.300 ± 0.061	0.056 ± 0.08
Weight	0.094 ± 0.076	0.015 ± 0.068	0.323 ± 0.060	0.090 ± 0.08
Number of rows	0.260 ± 0.072	0.127 ± 0.067	-0.061 ± 0.069	-0.034 ± 0.08
Weight of kernels	—	0.028 ± 0.068	—	0.043 ± 0.08
Ratio of tip circumference to butt circumference	—	-0.162 ± 0.066	—	0.014 ± 0.08
Percentage of grain	—	-0.177 ± 0.066	—	—

Thus the only characters showing any considerable correlation are length and weight ear. Of the 8 correlations obtained for these two characters in the two years, two are about five times their probable error, so that these correlations can hardly be considered significant. (See also *B. May* 1912, No. 491).

CUNNINGHAM, C. C. (Relation of Ear Characters of Corn to Yield, *Journal of the American Society of Agronomy*, Vol. VIII, p. 188, 1916), of the Kansas Experiment Station, studied the relation of the ear characters to yield in a number of varieties. He found some variation in length of ear in the different varieties. In the small varieties the long ears yielded a little better than the medium and short ears, but this did not apply to the larger varieties. There was no significant difference in the averages for all varieties. Ears with small circumference yielded the large ears. There seems to be no relation between the filling out of the tips of ears and yield. Smooth ears out-yielded the roughly dented ears. Ears with low percentage grain yielded slightly higher than those with the higher percentages of grain. Ears with and 18 rows of kernels generally gave the highest yields, though, in this character, there was difference in varieties.

9 - **Breeding Sweet Corn Resistant to the Corn Earworm.**—COLLINS, G. N. and KEMPTON, T. H., in the *Journal of Agricultural Research*, Vol. XI, No. 11, pp. 544-572. Washington, December 10, 1917.

In the south of the United States and throughout the American tropics the production of sweet maize is greatly hampered by the ravages of the maize earworm (*Chloridea obsoleta* Fab., of the Noctuidae family), which are so serious that, in some districts, the place of sweet maize has been taken by the more resistant field varieties.

In order to unite in a new variety the character "sweet grain" of sweet maize and that of "resistance to earworm" of field maize, a series of hybridisation and selection experiments were carried out from 1912 to 1916 at Victoria (Tex.), Chula Vista, near San Diego (Cal.) and Lanham (Md.). Crosses were first made between the three commercial varieties of sweet corn, Stowell's Evergreen, Early Evergreen and Early Cory, and two varieties of field corn, Brownsville and Marrainto. Brownsville was selected for its resistance to earworm; Marrainto, a variety from northern Mexico, is rather thicker and harsher husks than those of Brownsville. From among the hybrids obtained the four following were chosen:

Ph 75 (Brownsville × Early Cory)	Ph 79 (Stowell's Evergreen × Brownsville)
Ph 77 (Early Evergreen × Brownsville)	Ph 80 (Marrainto × Early Evergreen).

From the beginning of the experiment the four characters considered important in resistance to earworm were:—

- 1) *The distance which the husks extend beyond the tip of the ear*; as the larvae usually enter the ear from the tip of the shoot it is advantageous to increase the distance they must travel.
- 2) *The thickness of the cover of the husk*; as the larvae sometimes enter the ear through holes in the husk a thicker cover might hinder them.
- 3) *The texture of the husks*; in most sweet varieties the husks are relatively soft and smooth, while in field varieties they are firm and rough, sometimes even covered with firm spicules making their surface like sand-paper. This character might prevent the insects from eating through the husks.
- 4) *The husk leaves*; it was thought that ears without husk leaves might be less attractive to the moths.

The ears from the F_1 contained a mixture of sweet and horny seeds. In 1914 the sweet seed from selected ears of each of the four above-mentioned hybrids were sown in separate rows at Lanham, one row for each ear. Pollinations were then made of plants of similar appearance, usually within the same row, the characters described being recorded for each plant. Preference was given to plants with long husks and few husk leaves, but other types, including a few that appeared inferior in worm-resistant characters, were not excluded. In 1915, 14 ears were selected and the grain from them sown at Chula Vista, where the earworm does more serious damage than at Lanham.

When the hybrids obtained in 1915 at Chula Vista were compared with other varieties of sweet maize growing in the neighbourhood, the hybrids were found to have suffered less than the other varieties. All condi-

tions being equal, and the effect of competition in adjacent lines (1) being taken into consideration, some lines showed greater resistance than others; thus, the hybrid Ph 124 (Stowell's Evergreen \times Brownsville) was 7 1/2 times more resistant than Ph 125 (same cross). This proves that *different plants from the same ear are distinguished by a special degree of resistance*.

In 1916, 35 rows were planted at Lanham, distributed as follows: —

- 14 rows of the 1915 hybrids.
- 9 from ears obtained by hand pollinations within the rows of the 1915 row
- 8 rows from ears obtained by crosses between the rows in 1915.
- 2 rows of F_1 crosses between 1915 lines and Hopi maize
- 1 row of Oregon Evergreen (P 129), a commercial variety of sweet maize
- 1 row of New Century Wonder (P 125), a commercial soft variety sold as table maize

The results confirm those of 1915. Ph 124 retained its superiority showing the character "*resistance to earworm*" to be hereditary. Moreover, the degree of immunity may increase from one generation to the other as shown by the correlation 0.66 ± 0.09 for damage done by earworm. On the other hand, three varieties of sweet maize used for comparison, Oregon Evergreen, one of the most resistant commercial varieties of sweet maize and two Hopi hybrids, Ph 137 and Ph 141, were seriously injured by the parasite.

CHARACTERS CORRELATED WITH RESISTANCE : —

- 1) *Damage*, expressed by a scale from 1 to 10, where 10 expresses complete destruction of the ear.
- 2) *Number of larvae*.
- 3) *Damage per larva*.
- 4) *Prolongation of husk*; the distance from the tip of the ear that of the husk expressed in centimetres.
- 5) *Length of ear*.
- 6) *Length of husks*.
- 7) *Number of husks*.
- 8) *Number of layers forming the husk*.
- 9) *Number of days from planting to silking*.
- 10) *Maturity*; the proportion of opaque to transparent endosperm estimated in a section of the grain, according to a scale of from 61 to 15; below 6 the grain is not marketable.
- 11) *Number of days from silking to harvest*.
- 12) *Husk leaves*; the development is in accordance with a scale 1 to 10.
- 13) *Number of rows*.

The correlation of the characters *prolongation, length of husks, number of layers, days to silking, to damage* are expressed by coefficients equals or above 0.35. There is positive correlation between

- Prolongation and Length of husks.*
- Length of husks and Length of ear.*
- Number of husks and Number of layers.*

(1) See No. 374 of this Review. (Ed.)

Number of layers and Days to silking.

Days to silking and Maturity, Days from silking to harvest, Husk leaves.

Maturity and Days to harvest, Husk leaves.

These correlations must be borne in mind so that an eventual immunising effect may not be wrongly attributed to one of a pair of correlated characters.

ANALYSIS OF RESULTS. — Prolongation of husks. — One of the chief differences between sweet maize and field maize is the greater length of the husks which greatly exceed the lip of the ear in the latter; the larvae of the earworm must thus travel a greater distance to reach the tip. This explains the greater resistance of the field variety. A correlation between *age* and *length of husk* is, therefore, to be expected. Such a correlation 0.71 ± 0.06 is, indeed, found, whereas the relation of *regression of damage (x) to length of husk* is expressed by the coefficient 1.02, i. e. an increase of 1 cm. in prolongation may save 1 % of the crop. Amongst 14 progeny with an average prolongation of 2.9 cm. there was a loss of 10 %, and among those with an average prolongation of 7.7 cm. the loss dropped to 5 %. In other words, an average increase of 4.8 cm. in prolongation was accompanied by an average reduction of 5 % in damage (or about $\frac{1}{100}$ per centimetre).

Number of layers and number of husks. — The coefficient of correlation between this character and damage is high — 0.52 — but as only 4.5 % of the larvae enter the ear by penetrating the husks, there cannot be said to be any direct relation as to cause and effect between the number of layers and damage. The protective effect of the layers is also partly due to other characters correlated with thickness which has not been considered in these experiments (partial correlation).

Husk Leaves. — The larger the leaves the larger the space over which the moth can deposit eggs. The positive correlation between damage and husk leaves is 0.31 ± 0.11 . In selection, therefore, forms with very large husk leaves should be avoided.

(1) When the coefficient of correlation between 2 characters and the standard deviation of one of them is known the *coefficient of regression* may be easily calculated. For example, to obtain the coefficient of regression of the weight of the ear as related to its length, the coefficient of correlation between *weight* and *length* is multiplied by the standard deviation from the average length, and the product divided by the standard deviation from the average weight, using the

formula $r = \frac{\sigma_w}{\sigma_l}$, where W represents the weight in ounces and L the length in inches.

Similarly, to calculate the coefficient of regression of the length as related to the weight,

formula $r = \frac{\sigma_l}{\sigma_w}$ is used. Supposing, for example, that the coefficient of regression

of the weight as related to the length is 2.03 and that, in certain groups of ears in a field, the standard deviation from the average length of the group in relation to the average length of the crop is 1.2 inches, by multiplying this deviation by the coefficient of regression, these ears may be said to weigh $2 \times 2.03 = 4.06$ ounces more than the average weight of the ears of the crop.

The coefficient of regression thus gives a specific relation between the standard deviation of one of the correlated characters, so that, if the standard deviation of one of them be known, it is possible to calculate the standard deviation of the other. — Cf. DAVENPORT, E., *Principles of Statistics*, pp. 166-168. (Ed.)

Number of larvae and damage per larva. — These values are low in resistant lines. As the number of larvae depends greatly on the degree of attraction of the plant for the female moth, it may be assumed that the plants avoided by the moths are those most distasteful to the larvae. It is probable that this agreement between the instinct of the larva and the moth depends less on the morphological characters of the plant than on chemical differences, probably on the presence of some volatile substance distasteful both to the larva and to the moth. We have, therefore, one of the characters which have not been considered in these investigations although it is closely correlated with damage.

Other characters. — The coefficients of correlation are low and of no importance in practical selection.

CONCLUSIONS. — 1) An increase in the length and thickness of the husk covering, and a reduction of the husk leaves increase resistance to earworm.

2) By crossing sweet maize and field maize varieties, the character "sweet grain" and "resistance of the ears to earworm" may easily be united in one variety in ever-increasing proportions.

280 — **Correlations Observed in Maize Grains, in U. S. A.** — See No. 271 of the *Review*.

281 — **Inheritance of Abbreviation of Growth in the Cultivated Carrot and Beet.** DANIEL, LUCIEN, in *Comptes rendus des Séances de l'Académie des Sciences*, Vol. CLX, No. 25, pp. 1012-1014. Paris, December 17, 1917.

In 1916 the author described his studies on certain nutrition modifications caused by the sea climate and sandy soil in plants transferred from Rennes (Ille-et-Vilaine) to Erquy (Côtes-du-Nord), by the sea (1). He showed that most of these variations were not hereditary, but disappeared with inland cultivation. He extended his observations to the study of the inheritance of other phenomena which appear to be more frequent at the coast, particularly the inheritance of abbreviated growth in carrot and beet, which sometimes give annual plants of no, or of only very minimum, utilitarian value.

(1) DANIEL, LUCIEN, Cultures expérimentales au bord de la mer, in *Comptes rendus des Séances de l'Académie des Sciences*, Vol. CLXIII, No. 18, pp. 483-486. Paris, Oct. 30, 1918.

The author summarised as follows the results of his experiments carried out during years at Erquy: —

1) In 15 years the plants transferred from Rennes to the coast at Erquy, acquired not lophytic characters although subjected to the influence of fog and occasional watering with salt water.

2) The only distinct variations were those caused by the very marked oscillations of the water (quantity, quality and salt content), which caused dwarf and giant plants and the intermediate stages. This action is entirely transitory, both in the experimental plants themselves and in their descendants. It does not appear to be hereditary so far as judged from the negative experiments and their short duration (15 years) as compared with repeated action during many centuries. Giant or dwarf plants, so common on the sea coast according to the degree of moisture at the station, rapidly lose their peculiar characters on land, thus again confirming the non-inheritance of these phenomena.

His experiments, which are still being continued, were carried out simultaneously at Rennes and at Erquy and gave the following results: —

- 1) The abbreviation of growth is partially hereditary, to a degree varying with the conditions of cultivation in a first generation;
- 2) The sensibility to the variation is specific and greater in the variety of carrot studied than in that of beet;
- 3) The abbreviation of growth varies with the individual and may be accompanied by unexpected variations showing that the stability of the race has been deeply shaken;
- 4) Care must be taken not to use seed of annual carrots and beets; the mixing of such seeds with pure ones should be suppressed.

32 — **The Selection of Some Varieties of Swede Resistant to *Plasmodiophora Brassicae*, in Denmark.** — CHRISTENSEN, C. I., in *Tidskrift for Plantæogl.*, Vol. XXVI, Part. 1, pp. 68-82. Copenhagen, 1917.

The English variety Pioneer, of Driffield, Yorkshire, is known to be resistant to the attack of *Plasmodiophora Brassicae*, which causes great damage to swedes in Denmark every year. For this reason, the discovery of two new varieties of swede more resistant than Pioneer to the disease, is worthy of special notice.

One was isolated from the type-variety Klank belonging to the "Triplum" Society of Copenhagen; the other came from the Studsgaard Experiment Station. The article describes the results of a series of selections carried out at Studsgaard during 1909-1916, with excellent results. In the autumn of 1908, the author collected 18 healthy, well-developed specimens on plots very badly damaged by *Plasmodiophora*. Some of these choice specimens went bad during the winter; 11 remained and were planted in the spring of 1909, well isolated to prevent cross-fertilisation.

Sufficient seed was collected from 10 of the plants to allow study of the progeny. The aim was to ascertain whether resistance to *Plasmodiophora* is hereditary. Ten families were named, one for each seed plant: Långholm Fam. 1, Fam. 2, etc. The seed was sown on plots that had produced swedes for the two previous years that were badly attacked by *Plasmodiophora*. The results for 1910 are given in Table I. The progeny are divided into 3 groups: 1) perfectly resistant; 2) slightly attacked, but the root retains its form and can be fed to cattle; 3) badly attacked, the root being completely spoiled. Column 8 in the table shows the degree of intensity of the attack for each family, calculated according to the formula: $K = \frac{0 \cdot a + 1 \cdot b + 2 \cdot c}{a + b + c} \times 10$, where a equals the number of un-

attacked roots, b , the number of slightly attacked roots, c the number of badly attacked roots, and n , the total number ($a + b + c$) of roots.

The progeny of 87 roots, chosen with no criterion of immunity, and sown under similar conditions, and quite near to the experimental plots, were almost completely destroyed by *Plasmodiophora*: degree of intensity of the attack = 14. The attack was much reduced in the case of the 10 Långholm families coming from resistant plants; the intensity being 4

(maximum) given by Fam. 1 and 2, and 0.4 (minimum) given by Fam. 4, which was also notable as being almost completely immune.

The 1912-1913 Experiments confirmed those of 1910. During this time, by means of continuous and minute selection in the Studsgaard experimental fields, some lines were isolated that had a high degree of resistance, as was shown by trials in 1914, 1915 and 1916.

TABLE I. — *Demonstration of the transmissibility of the character "resistance to Plasmidiophora Brassicae". 1910 results.*

	Number of roots per plot				No. of roots %				Kg. of roots per plot			
	immune	slightly attacked	badly attacked	Total	immune	slightly attacked	badly attacked	Total	immune	slightly attacked	badly attacked	Total
Pioneer.	24.6	1.7	2.7	29.0	85	6	9	100	15.6	0.9	0.4	16.9
Bangholm (ordinary)	5.3	8.3	15.4	29.0	18	20	53	91	3.3	6.2	3.2	12.7
Bangholm, Fam. 1	21.4	3.3	3.3	28.0	76	12	12	100	13.8	2.9	1.2	17.9
" " 2	23.3	5.0	2.0	30.3	77	16	7	100	12.7	2.1	0.2	15.0
" " 3	23.3	5.0	0.7	29.0	81	17	2	100	16.8	1.9	0.2	18.9
" " 4	29.0	1.3	0.0	30.3	96	4	0	100	19.6	0.9	0.0	20.5
" " 5	24.3	3.7	2.3	30.3	80	12	8	100	22.1	2.0	0.4	24.5
" " 6	22.3	1.7	1.3	25.3	88	7	5	100	18.1	0.9	0.4	19.4
" " 7	23.3	2.7	3.0	29.0	81	9	10	100	16.6	1.7	0.5	18.8
" " 8	23.0	3.0	2.7	28.7	80	11	9	100	18.6	2.2	0.5	21.3
" " 9	21.0	5.0	1.0	27.0	70	17	13	100	17.6	2.9	0.9	21.4

TABLE II. — *Table showing the degree of resistance of the progeny (1916).*

	Hundreds of roots per hectare				Number of roots %			
	immune	slightly attacked	badly attacked	destroyed	immune	slightly attacked	badly attacked	destroyed
Bangholm Fam. 4.	444	76	9	4	533	83	14	2
" " 25.	421	63	8	21	513	82	12	2
" " 19.	387	108	15	9	519	74	21	3
" " 21.	374	106	20	20	520	72	20	4
" " 26.	356	88	40	22	506	70	18	4
" " 3.	309	127	50	19	511	60	25	11
Bangholm, Pajberg III (ordinary type)	15	194	148	93	450	3	43	21

In Table II (1916), in order to find the value of K , the progeny are divided into 4 groups: — 1) immune; 2) slightly attacked; 3) heavily attacked; 4) almost completely destroyed. The formula $K = \frac{0. a + 1. b + 2. c + 3. d}{n} \times 10$ is used, where d equals the number of plants entirely destroyed (a, b, c as in the preceding formula).

Among the new forms, Fam. 25 and 19 deserve attention both for resistance and yield (see Tables II and III). They come close to No. 4, which, however, always maintains its first place. This shows the excellent results obtainable by individual selection.

TABLE III. — Data on the 1916 root crop.

	Dry matter per hectare, in quintals	Roots per acre, in quintals			Total	%
		immune	slightly attacked	heavily attacked		
holm Fam. 4. . . .	83.7	486	87	4	577	14.5
25. . . .	80.6	506	76	2	584	13.8
19. . . .	74.0	432	117	7	556	13.3
3. . . .	73.7	364	120	24	508	14.5
26. . . .	69.6	399	85	17	501	13.9
21. . . .	67.9	363	93	12	468	14.5
holm Pajberg III primary type). . . .	49.0	13	271	99	383	12.8

— **Flaxwilt: A Study of the Nature and Inheritance of Wilt Resistance.** — TISDALE, W. H., in the *Journal of Agricultural Research*, Vol. XI, No. 11, pp. 573-603, plates 44-46. Washington, December 10, 1917.

The experiments described were carried out in February, 1915, at the University of Wisconsin. Crosses were made between a variety of flax resistant to wilt (*Fusarium lini* Bolley) — North Dakota Resistant 114, designated in the article as No. 4 — with 3 other varieties more or less susceptible to the disease, namely, No. 3, from Dakota, No. 5, with white flowers Red Wing, Minn., No. 6, from Devil's Lake, N. Dakota., and the colour of the hybrids obtained observed.

Only one of the crosses, that between the resistant variety No. 4 and most susceptible variety, No. 3, gave results which could be explained by Mendelian formula. The resistant plant was used as female parent, the progeny designated as 4 D 20, where 4 represents the strain D the one on which it was grown, and 20 the number of the female plant. The 26 F_1 seeds thus obtained remained perfectly healthy, whereas the No. 3 component wilted entirely. In the F_2 , of 530 plants, 162 were resistant and 368 wilted, giving a ratio which makes it impossible to attribute the character "resistance to wilt" to one single factor. If, however, 4 factors concerned, these figures (or rather their halves, 81 and 184) are close

to the theoretical figures, 81 resistant to 175 susceptible, corresponding to the Mendelian ratio 1 : 2.16.

However, as has already been said, this cross was the only one the results of which could be explained; in all the others the ratio between resistant and susceptible plants varied so greatly that it could not be accounted for by admitting a constant number of factors. In the F_1 we obtained both more or less resistant plants and very susceptible plants, but in most cases, intermediate forms, expressed by very varying factors. It must be pointed out that some of the hybrids with the same degree of susceptibility (percentage of dead plants at the end of the experiment) the susceptible parent plant sometimes showed a marked difference from this parent as to the date of starting, rapidity and duration of the infection; in some plots of susceptible hybrids the first symptom of disease began to appear when the control parent plants were already wilted to a large extent.

It must be noted that the environmental conditions during the experiments were far from uniform especially as regards the state of the soil which was sometimes naturally and sometimes artificially infected, thus affecting the resistance of the plants. It seems possible that the complex phenomena observed in these hybridisation experiments may be explained by the specific action of external factors on resistance to wilt. The resistant strain No. 4 was selected to withstand the disease under normal environmental conditions. In this case the factors A, B, C, D, are sufficient to produce immunity, so long, of course, as they are homozygous (AA, BB, CC, DD). When, however, extraordinary conditions (temperature, unsterilized soil) favourable to the growth of the parasite are artificially created the action of A, B, C, D, becomes insufficient, and part at least of the hybrid resistant under normal conditions, break up into resistant and susceptible plants. In such cases, to regain immunity, other factors, E, F, etc., must be taken into consideration. This has evidently not been done for strain No. 4, selected for growth under normal conditions. The factors in the line may be: — 1) entirely absent, 2) present singly, 3) present in combination, either homozygous or heterozygous. The differences in the results obtained would be thus explained.

The wilting of the plants attacked is due to the combined action of the following factors: — 1) destruction of the root system; 2) use of food and water supply of the plant by the fungus; 3) more vigorous growth of the fungus and increased transpiration of the host plant due to a rise in temperature; 4) the possible production by the fungus of toxins injurious to the host protoplasm. What is the specific behaviour of the resistant plants towards the pathogenic agent? The mycelium penetrates the root hairs, epidermal cells, the stomata of seedlings, and perhaps also wounds of both resistant and susceptible plants. In the latter it develops rapidly, killing the tissues, whereas, in the former, it is unable to penetrate the tissues. This may be due to: — a) the permanent chemical composition of the resistant plant may be injurious to the fungus, b) the protoplasm of the resistant plant may be more sensitive than that of the susceptible

lant. thus reacting more readily in the production of the phenomena causing wilting; c) below and around the point attacked the cells of the parenchyma, which form a fourth layer, divide and thicken their walls with a substance giving the suberin reaction; the cork layer thus formed isolates the infected zones, preventing further progress of the hyphae.

84 - **Selection of Pea seed.** — BEVERLEY, J., in *The Journal of Agriculture, New Zealand Department of Agriculture, Industries and Commerce*, Vol. XV, No. 4, p. 216. Wellington, New Zealand, October, 1917.

The experiments were carried out to ascertain whether the number of peas in the pod has any influence on the vigour and yield of the future crop. The results for the season 1916-1917 were: —

Variety	Number of peas in pod	Plant vigour expressed	Seed yield expressed
Beverley's No 1 pea.	Average: 8 or less	100	100
	Once selected: 10	105	140
	Twice selected: 10	105	156

The results are positive and clearly show the effect of selection. The seed from pods containing 10 produce better developed and more productive plants than those from pods containing 8 or less. The seed from the 1st. generation of pods containing many peas gives a yet higher yield in the 2nd. generation.

85 - **Asparagus Selection in Massachusetts, U. S. A.** — *Twenty-Ninth Annual Report of the Massachusetts Agricultural Experiment Station, Public Document No. 31*, pp. 23-24. Boston, January, 1917.

The asparagus selection work at the Concord Substation, Massachusetts, is in charge of Prof. J. B. NORTON. Starting with the common commercial varieties he successfully isolated strains distinguished, not only by their vigour, and the quality and quantity of their produce, but also by marked resistance to rust (*Puccinia Asparagi* D. C.).

For testing purposes were distributed: — in 1915, to 99 growers, 68 lots of roots of 50 each, and 217 ounce packets of seed; in 1916, to 74 growers, 7 lots of roots of 100 each and 43 ounce packets of seed of the new varieties.

All the reports were favourable, both as regards the produce and the rapidity and vigour of growth. In no case was rust reported, but, in view of the relative freedom from rust attacks in 1915-1916, the results of further tests must be awaited before any definite opinion as to immunity to this disease can be passed.

86 - **Hybrid Chestnuts in the United States.** — MURRILL, W. A., in the *Journal of the New York Botanical Garden*, Vol. XVIII, No. 214, pp. 213-215. Lancaster, Pa., October, 1917.

The paper refers to certain chestnut hybrids obtained and cultivated by Mr. VAN FLEET in his experimental grounds several miles to the north-

east of Washington. The following lines were used for propagation and study: American chinquapin chestnut (*Castanea Chincapin* Hort. = *pumila*), Japanese chestnut (*C. japonica* var. *pubinervis* Makino), and Chinese chestnut (*C. chinensis* Hassk. = *C. sativa*).

CHINQUAPIN × JAPANESE. — Among the hybrids were found all the stages intermediate to the large, sweet chinquapin and the Japanese type with fruit fine, but of poor flavour and good only for cooking. The more chinquapin stock present, the better is the flavour. All these hybrids were immune from chestnut canker or blight (*Diaporthe parasitica* Murr.), and some produced excellent fruit.

CHINQUAPIN × CHINESE. — The use of the Chinese chestnut is to be recommended because of its sweet, soft-skinned nut, much larger than that of the chinquapin. These hybrids, however, are not immune to canker, which sometimes attacks the trees very seriously. It seems best to grow them in shrubs with several trunks, so that, if one is attacked, it may be cut immediately and its place taken by another.

Mr. VAN FLEET's hybrid chestnut plantation covers an area of about 4 acres. The trees are planted at distances of 6 to 8 feet from each other in rows 12 feet apart.

287 — Winter Wheats in the United States. — See No. 257 of this Review.

288 — The Characters and Yields of Australian Wheats. — See No. 342 of this Review.

289 — Some Effects of the Successive Cropping of Barley. — GERICKE, W. P., in the *Journal of the American Society of Agronomy*, Vol. IX, No. 7, pp. 325-332. Washington D. C., October, 1917.

The experiments described, carried out in the Laboratory of Soil Chemistry of the University of California, Berkeley, form part of a study undertaken to investigate the effects of successive cropping of barley on soil in pots under greenhouse conditions. All the factors of production, except the soil, were the same or similar throughout the experiment. Five kilograms of soil were put in each pot, some of which were sown and some

TABLE I. — Yield and ripening, as affected by successive cropping.

Number of crops in one soil	Number of stalks total per pot	Number of stalks			Period of harvest	
		grain producing	producing heads but no grain	producing no heads	first heads ripe	Last heads ripe
4	5	5	0	0	June 1	June 11
4	6	6	0	0	June 1	June 11
3	20	6	6	8	June 15	July 7
3	12	6	4	2	June 15	July 8
2	21	6	10	5	June 15	July 10
2	23	8	9	6	June 14	July 10
1	29	13	11	5	June 15	July 8
1	40	10	16	14	June 16	July 12

left unsown; so that a series was obtained in which some had produced three crops, some two, some one, and some no crop. Throughout the experiment the culture and water content of the soil was the same for each pot whether it contained growing plants or not. The soil was well supplied with the necessary plant-food constituents and was particularly rich in nitrogen. Analysis by the strong acid digestive method showed it to have the following composition: — insoluble residue, 64.85 %; soluble silica, 9.18 %; Ca O, 2.26 %; Fe_2O_3 , 45.9 %; Al_2O_3 , 5.80 %; SO_3 , 0.4 %; Mn_2O_4 , 0.13 %; Mg O, 0.72 %; K_2O , 0.62 %; Na_2O , 0.43 %; P_2O_5 , 0.48 %; loss on ignition, 11.94 %; total nitrogen, 0.31 %; humus, 3.20 %; nitrogen in humus, 3.30 %.

The seed used was from a very pure strain of Beldi barley. The appended tables show the results of the experiments.

TABLE II. — *Average height in centimetres of the different classes of stalks as affected by successive cropping.*

Number of crops in one soil	Average height of all stalks	Average height of grain-producing stalks	Average height of stalks producing heads but no grain	Average height of stalks producing no heads
.....	68.6	68.8	—	—
.....	66.6	66.6	—	—
.....	40.7	53.2	29.2	40.1
.....	38.2	42.5	27.5	53.0
.....	35.1	49.7	31.8	24.4
.....	31.6	41.2	29.6	22.7
.....	31.1	38.6	25.8	23.4
.....	28.9	49.0	29.0	20.3

TABLE III. — *Relation of height of stalk to weight of grain as affected by successive cropping.*

Number of crops in one soil	Pot 1				Pot 2			
	Height of stalk	Number of kernels in head	Weight of kernels in head		Height of stalk	Number of kernels in head	Weight of kernels in head	
			total	average of 1 kernel			total	average of 1 kernel
	cm.		gm.	mgm.	cm.		gm.	mgm.
(average of 6 stalks)	68.6	26.2	1.311	30.0	66.6	20.1	1.387	47.5
(average of 6 stalks)	53.1	21.6	1.019	47.0	42.5	19.7	0.804	45.4
(average of 8 stalks)	49.7	28.7	1.074	37.5	41.2	17.2	0.711	41.2
(average of 13 stalks)	38.6	15.0	0.665	41.8	40.9	17.2	0.731	42.5

CONCLUSIONS: 1) Plants of the 4th. crop matured with a greater uniformity than those of any other crops. None of them had barren stalks. The number of tillers and barren stalks increased with the plants grown in oil which had produced a lesser number of crops.

2) The total height of all the stalks produced decreased with each successive crop, but the average height of the individual stalks increased with each successive crop.

3) In the 4th. and 3rd. crops the heaviest grain, both in weight per head and in average weight per kernel, varied with the height of the stalks. The tallest stalks produced the largest ears and highest average weight per kernel.

4) In the 2nd. and 1st. crops there was no correlation between the height of stalks and weight of grain per head or average weight per kernel.

290 - Studies on Maize in the United States: Influence of Position of Grain in the Cob on the Growth of Maize Seedlings. — See No. 271 of this Review.

291 - The World's Production of Rice. — See No. 251 of this Review.

292 - The Utilisation of the Civet Bean (*Phaseolus lunatus*) Cultivated in Madagascar. — PRUDHOMME, E. and RIGOTARD, L., in *Feuille d'Informations du Ministère de l'Agriculture*, Year XXIII, No. 5, p. 6. Paris, January 29, 1918.

During the last 15 years the cultivation of the civet bean in Madagascar has increased considerably and it is exported in ever-growing quantities; from 17 700 cwt. in 1910 the exportation has risen to nearly 177 000 cwt.; the 1917 harvest is estimated at 196 800 cwt.

The authors discuss the value of the civet bean as a food. It is particularly appreciated in England, where, under the common name of "butter bean", it is eaten like the ordinary dried bean, and is even considered a choice food.

The authors have recently examined many samples of civet beans at the Colonial Garden. The results of the examination of many varieties confirm the statement that large, flat, white seeds, or those with pink spots at the end or near the hilum, about 22 to 24 mm. long, 13 to 15 mm. wide and 6 mm. thick, only contain from 5 to 7 mgm. of hydrocyanic acid per 100 gm. of seed. The average weight of 100 such seeds is between 175 and 189 gm.

Mr. KOHN ABREST, Director of the Laboratory of Toxicology of the Paris Police Service, supplied the authors with data which prove the civet beans grown at Madagascar to be those of all the numerous varieties of *Phaseolus lunatus* which yield the least hydrocyanic acid. They may be eaten without any danger as is shown by the quantities of acid found on analysis: — 100 gm. of beans of this quality contain barely 2 to 3 mgm. of hydrocyanic acid, if the water in which they are soaked and cooked is thrown away. This amount is harmless to adults.

The sale of the beans should be controlled and the hydrocyanic acid content limited to 10 mgm. per 100 gm. of beans. For this it would be sufficient according to the author's studies, to limit the importation to large, flat seeds, the weight of which varies from 1 000 to 15 000 gm. per 1 000 seeds, either entirely white in colour, or slightly mottled with red or pink.

3 - **Winter Potato Growing in the Algerian Sahel.** — BISSON, ANTOINE, in the *Bulletin de la Direction Générale de l'Agriculture, du Commerce et de la Colonisation de la Régence de Tunis*, Year XXI, No. 90, pp. 22-27. Tunis, 1917.

In view of the increasing cultivation of the potato in Algeria for export and the absolute lack of sufficiently detailed literature on the subject for the use of the farmer, the author gives information he has been able to collect by his own experiments and numerous observations on the cultivation of the early potato.

To obtain good results planting must be early, which, moreover, allows a second crop of tobacco, maize or red potato. The potatoes may be planted between rows of vines; the cultural methods and fertilisers indispensable to the potato also benefit the vine, and, as the potatoes are lifted before the vine shoots appear the care of the latter can proceed normally.

A detailed study is made of: — 1) choice of land, 2) preparation of the soil, 3) live or dead shelter-hedges, 4) choice of seed (the varieties most to be recommended are: Grenadine or native potato; Royale Kidney hâtive; La Hâtive; Royale Kidney Allemande or Belle de Juillet, harvested in France; Royale Kidney Allemand or Belle de Juillet, harvested in Germany; Flouque de Jersey; Hainaut or Belle de Fontenay); 5) sprouting of the potato, 6) planting, 7) watering, 8) copper sulphate spraying, 9) cultivation, 10) lifting, 11) sorting, 12) fertilisers.

4 - **A "Water Potato".** — ROSS, D. M., in *The Journal of Agriculture, New Zealand Department of Agriculture, Industries and Commerce*, Vol. XV, No. 4, pp. 209-210. Wellington, October, 1917.

In the Bay of Plenty district, New Zealand, on the northern bank of the Rangitaiki River, near a fresh water spring, a strong variety of edible potato is found growing amongst watercress (*Nasturtium officinale*). The roots and tubers of the plant are found from 12 to 17 inches below the water. The potatoes are of fair size and ripen as early as August; when cooked they are waxy.

The author sent some of the tubers to the Moumahaki Experimental Farm to see if they could be grown on dry land. Planted on August 31, 1916, they gave vigorous plants with distinct foliage and large blue flowers which bore seed-apples. The crop was lifted on February 6, 1917, and was free from disease. The yield was 12.87 tons per acre, 11 tons of which are marketable (table and seed) and 1.87 tons were pig-potatoes. Boiling tests showed that the potatoes kept their colour well but could not be classed as good cookers. The starch content appears to be high.

195 - **Three Fodder Pulses of Bihar and Orissa: Meth, Bhiringi and Mashyem Kalai.** — GOSH, A. C., in *Department of Agriculture, Bihar and Orissa, An Agricultural Journal*, Vol. V, No. 1, pp. 15-17, 14 tables, 5 plates. Patna, 1917.

A systematic study has been made of the pulse crops grown in the botanical experimental area at Sabour (Bihar and Orissa, India). A botanical description and detailed observations are given of the different varieties, natural crosses, soil, sowing, cultivation, uses, etc.

Some of the most important data on Meth (*Phaseolus Ricciardianus* Ten.), Bhiringi (*Phaseolus aconitifolius* Jacq.) and Mashyem Kalai (*Phaseolus calcaratus* Roxb.) are given in the following table.

	<i>Phaseolus Ricciardianus</i> (1)	<i>Phaseolus aconitifolius</i> (2)	<i>Phaseolus calcaratus</i>
Length of main stem	1-2 ft.	1-3 ft.	16-27 in.
Yield } green fodder (average of 3 tests)	10323 lbs.	3700 lbs.	10057 lbs.
per acre } grain	523 lbs.	—	532 lbs.
Composition of green fodder:			
Water	62.73 %	50 %	70.29 %
Albuminoids	5.02	6.94	3.97
Amides	1.53	1.13	0.93
Crude fibre	3.18	4.25	3.42
Ash	5.11	8.91	3.42
Silica in ash	1.65	4.88	0.03
Digestible carbohydrates	22.43	28.77	17.97
Composition of unhusked seed:			
Moisture	8.10 %	8.65 %	9.83 %
Ether extract	0.50	0.68	0.38
Albuminoids	21.52	22.38	20.42
Nitrogen in albuminoids	3.40	3.58	3.27
Crude fibre	6.38	3.88	4.33
Digestible carbohydrates	59.62	60.59	60.61
Ash	3.87	3.83	4.33
Silica in ash	0.07	0.07-0.1	0.002-0.02

(1) Yellow seed variety. (2) Black mottled seed variety.

USES. — *Ph. Ricciardianus*. — Chiefly grown for green fodder. The seeds, though indigestible, are used as human food; entire or partly crushed seeds steeped in water overnight are given to cattle and horses. The straw and husks are used as a food for cattle.

Ph. aconitifolius. — The seed is used for human consumption. The pod husks and straw are fed to cattle.

Ph. calcaratus. — Grown particularly for green fodder. The seed, first baked and crushed, may be used for human consumption.

296 — Grass Experiments at Hawkesbury Agricultural College, 1916-17. — KERLE, D., in *The Agricultural Gazette of New South Wales*, Vol. XXVIII, Pt. 2, pp. 809-7 Sydney, November, 1917.

The year ending June 30, 1917, was exceptionally dry. The rainfall was 29.670 inches, nearly half of which fell during the three months October-December.

The experiments were divided into two series: 1) rows of 116 ft. in length and 2 1/2 feet apart, 2) field plots of 1/4 acre.

The first trials, besides their use for study and instruction, had as aim a) to determine the suitability to the district of the common native and int

luced grasses; b) to determine the value of newly-introduced grasses; c) to improve varieties by selection.

The second trials aimed at: — a) testing under ordinary field conditions those varieties which had given good results in the row trials; b) to establish seed reserve areas, the seed of the best plants being distributed to the farmers for testing. The soil was a light volcanic loam of comparatively uniform composition.

ROW TRIALS. — Three new grasses were tested: *Pennisetum massaicum*, *P. trislachya*, and *Setaria nigrirostris* (South African Pigeon Grass). The first proved worthy of further trials. It stooled well, resisted several severe frosts in early winter, grew to a height of 2 ½ feet, but was eventually destroyed by a succession of very heavy frosts. The second, a native of Brazil, did badly. The third stooled well, grew strongly in autumn and reached a height of 5 ½ feet; it, however, gives a coarse fodder and is killed by frost.

Field trials. — As the row trials, these were started in 1913.

In 1913 were grown: —

Eragrostis curvula, var. *valida* (a Love grass) — *Andropogon intermedius* (Rare blue grass) — *Eragrostis leptostachya* (Paddock Love grass) — *Paspalum dilatatum* — *Chloris Gayana* (Rhodes grass) — *Anthistiria avenacea* (Tall Oat grass) — *Bromus inermis* (Awnless Brome grass) — *B. unioloides* (Prairie grass) — to which were added: in 1914: *Pollinia fulva* (Brown Top grass or Sugar grass); in 1915: three new strains of *Bromus inermis* — *Phalaris bulbosa* (Toowoomba Canary grass); in 1916: *Schedonorus Hookerianus* (Hookers Fescue) — *Festuca graminacea* (Giant Fescue) — *Pennisetum purpurum* (Elephant grass or Napier's Fodder grass) — *Andropogon Sorghum* var. (Sudan grass); in 1917: *Deyeuxia coarctata*.

Eragrostis curvula. — Gives a coarse fodder unsuited to cattle in New South Wales; discarded.

Andropogon intermedius. — Growth good; height 3 ½ feet; yield 3 tons 18 cwt. per acre; gives the highest yield of succulent forage of any of the New South Wales native grasses. Its chief merits are: — drought resistance, succulence, palatableness to stock, free seeding.

Eragrostis leptostachya. — A native grass; reaches a height of 2 ft.; very hardy; seeds freely; bears heavy stocking, average yield, 2 ½ tons per acre.

Paspalum dilatatum. — Considering the wetness of the beginning of the season, this plant grew and produced excellently (height 5 ft., yield 1 tons, 2 cwt. 3 qrs. per acre); in dry seasons it hardly grows at all, and therefore, can not be recommended.

Chloris Gayana. — Average height 4 ft., yield of forage 5 tons 5 cwt. 1 qrs. per acre; growth fair in both dry and wet seasons, but not readily eaten by stock because of its sour taste.

Anthistiria avenacea. — Native; drought resistant; height 5 ft. 3 in.; yield of greenstuff 5 tons 1 cwt. per acre; not to be recommended on account of its coarseness and poor seeding capacities.

Bromus inermis. — Height 2 ½ ft.; yield of grass 3 tons 5 cwt. per acre; is not well adapted to the coast, but does well in the northern and central Tablelands, and in the irrigation area.

Bromus unioloides. — The plot sown in 1913 has always given excellent harvests; the variety, normally annual, has there become perennial. Merits: — resistance to frost, free seeding habit, palatableness. Chief defect: — inability to withstand heavy grazing.

Pollinia fulva. — Native; height 3 ft. (rare); yield of greenstuff 4 tons 2 cwt. per acre; tender, relished by stock.

Phalaris bulbosa. — Height 5 ½ feet; yield 7 ½ tons per acre; fodder tender, easy to harvest and thresh; excellent hay; grain has high percentage of germination; resistant to cold, but only slightly so to hot, dry summers; the best winter and spring grass tested at Hawkesbury.

Schedonorus Hookerianus. — Native; drought and frost resistant; adapted to high districts; grows little, fodder coarse.

Festuca arundinacea. — Grows little; fodder coarse.

Deyeuscia coarctata. — Promising; fodder tender.

Pennisetum purpureum. — Great growth and very high yield, height 10 to 11 feet with 60 to 80 stalks per stool, 21 tons per acre; does not seed, but is easily propagated by cuttings or roots; dairy cows eat the whole plant when it is chafed, but otherwise only the leaves.

Andropogon sorghum. — It gave two harvests during the year, yielding a total of 6 tons 10 cwt. 0 qr. 15 lb.; a plot grown for seed threshed at the rate of 623 ½ lb. per acre. It gives a higher yield than Hungarian millet (*Setaria italica*); resists summer drought; grows rapidly; is specially suited for a hay or soiling crop. Of all the grasses tested at Hawkesbury this is the best adapted to dry climates, and, under normal conditions, is superior to the others as a hay or soiling crop.

297 — *Wrightia annamensis*, a Textile Fibre Plant of Indochina. — See No. 348 of this Review.

298 — **Strawberry Growing in the United States.** — DARROW, GEORGE, M. — I. Strawberry Culture in Tennessee, Kentucky and West Virginia. *U. S. Department of Agriculture, Farmer's Bulletin* 854, pp. 24, 11 figs., bibliography. Washington, August, 1917. — II. Everbearing Strawberries. *Ibid.* No. 901, pp. 19, 7 figs. Washington, November, 1917.

I. — Strawberries are very largely grown, both intensively and extensively, in Tennessee, Kentucky and West Virginia. Intensive methods are the best suited to the district. The author deals with the following points: — choice of farm; choice of field; preparation of soil; fertilisers (acid phosphate and steamed bone meal are most commonly used, being applied at the rate of 200 to 800 lbs. per acre; stable manure should only be applied to crops preceding strawberries); planting (at intervals of about 3 ft. in rows 3 ½ ft. apart; the distance between the plants should be reduced to 18 inches if there is any danger of the plants' being killed by insect larvae or drought after hoeing, the ground is usually covered with straw while the plant is growing); methods of cultivation.

The Klondike variety is that most extensively grown in Tennessee. The Aroma is found especially in the north of this State; round Nashville Gandy is preferred. In Kentucky, Aroma is considered the best variety, but in heavy clay soils Gandy is considered best. In other parts of Ken

ky and in West Virginia the chief varieties grown are Gandy, Aroma and Dunlap.

II. — Most of the European everbearing strawberries are descended from the Alpine strawberry. The American everbearing strawberries, however, are derived from a plant bearing flowers and fruit at all the stages of its development, found by Mr. SAMUEL COOPER in 1898 among plants of the Bismarck variety, considered to be a cross between the Pan American and the Bubach varieties. Mr. COOPER named this plant Pan American, and from it he obtained other varieties bearing fruit till autumn; amongst these may be mentioned: — Autumn, Productive, Superb (the widest grown and the best), Peerless, Onward, Forward and Advance. The value of the last four has not yet been determined, but Peerless seems to have characters superior to those of Superb.

Mr. HARLOW ROCKHILL, of Iowa has obtained many everbearing plants crossing the European variety, Louis Gautier, with the Pan American and other varieties which normally only bear fruit in early summer. The best known of the varieties thus obtained is Progressive (Dunlap × Pan American); mention may also be made of the varieties Iowa and Standpat (both derived from Pan American × Dunlap). Other varieties, the value of which has not yet been determined, have been obtained by different growers, especially at the Minnesota Agricultural Experiment Station.

The characters and adaptation to different parts of the United States are first examined, and the following points then discussed: — soil; time and method of planting; cultural methods; harvesting; yields. East of the Rocky Mountains the Superb variety is less productive than the Progressive, but, under favourable conditions, over 1000 quarts per acre may be obtained in summer and autumn. In the irrigated districts of Idaho, Oregon and Washington, where the conditions seem more favourable to this variety, the yields are higher. The early summer crop of Superb is generally larger, with bigger berries, than that of Progressive. The varieties of everbearing strawberries now on the market are: — Advance, American, Autumn, Forward, Francis, Iowa, Onward, Pan American, Peerless, Productive, Progressive, Standpat and Superb. The Superb and Progressive varieties are most widely grown. Another variety, obtained in 1910, Minnesota No. 1017 — distributed by the Minnesota State Horticultural Society, has been introduced on to the market. It is very vigorous and very productive, with globular, dark red, firm berries of excellent quality. Although grown in Minnesota and the neighbouring States, this variety is not to be recommended at present for general planting because, in certain districts, it has been found to show but slight resistance to cryptogamic diseases.

— **Raspberry Culture.** — DARROW, GEORGE M., in the *U. S. Department of Agriculture, Farmer's Bulletin* 887, pp. 44, 33 figs. bibliography. Washington, October, 1917.

In the United States the raspberry is grown, not only in small plantations for the home and local market, but, in some districts, as the principal commercial crop. Statistics show that, in 1909, there were 48 668 acres of raspberries in the United States.

The methods of cultivation on estates which specialise in raspberries are very progressive. Detailed information is given on : — choice of planting preparation of the land ; planting (there are 3 methods of planting — 1) the hill system, in which a horse cultivator is used on all sides of the plant ; 2) linear ; 3) hedges, where the cultivator is used in one direction only) ; manuring (an average of 10 tons per acre of stable manure, leguminous cover crops to be dug in as green manure) ; training and pruning ; winter protection.

The yields vary greatly according to the variety grown, the methods used, and climatic conditions. In New York the average yield is from 1,000 to 1,400 quarts of red raspberries per acre. In Colorado, the Marlboro variety, if well protected during winter, will yield over 4,000 quarts per acre. In the Puyallup Valley (Washington), fields of Cuthberts properly cared for will yield 6,000 quarts per acre, and the Antwerp, 8,000 quarts per acre.

The best varieties now grown are : —

RED AND YELLOW VARIETIES : Antwerp, Cuthbert, Eaton (including the varieties Idaho and Iowa), Empire, Golden Queen, Herbert, June, King, London, Marlboro', Miller, Perfection, Ranere (St. Regis variety), Ruby, Sunbeam, Superlative, Surprise, Welch.

PURPLE VARIETIES : Cardinal, Columbian, Haymaker, Royal (Royal Purple variety), Shaffer.

BLACK VARIETIES : Cumberland, Farmer (Pfum Farmer variety), Gregg, Hoosier, Kent, Ohio, Older, Pearl (Black Pearl).

A large part of the raspberry crop is marketed in the fresh state. The Census Bureau estimated the value of canned raspberries in 1914 to \$1,372,077.

300 — **Citrus Cultivation in Surinam.** — IJEMS, J. A., in *Departement van den Landbouw Suriname, Bulletin* No. 35, pp. 29 + plates. Paramaribo, November, 1917.

There are many orange trees scattered about the plantations in Dutch Guiana, but orange groves have only been formed there more or less recently ; the first, planted at Vredenburg, contained 142 trees. Near Surinam is a nine year old grove covering about 4 ½ acres, and another covering nearly 34 acres, composed of native citrus trees from 3 to 8 years old. Other groves have been planted near the Commewyne River. In order to increase the cultivation of citrus trees the Department of Agriculture of the Colony has recently distributed, amongst small holders, a large quantity of grafted orange trees. Of all tropical fruits the orange is the best adapted to export. Exportation was begun in 1907 and, since then, the local Department of Agriculture has shipped oranges and tangerines to Holland. From the point of view of the prices obtained the results were encouraging. In 1909, 0.24 d. was obtained per orange sold in Holland ; in 1910, ½ d., in 1914, 0.36 d. In 1911, as a result of delay in departure and voyage of the boat carrying them, the oranges arrived in Holland in an unsaleable condition. In 1912, as the crop was poor, no fruit was exported. The experiment was a complete failure in 1913 as a result of the unfavourable shipping conditions. As the boats were not suitably fitted for carrying oranges, a large number of damaged fruit was found in all the shipments to Holland. According to the author, there is no doubt that, when normal

ions prevail again, the shipments may be re-started under conditions favourable to the keeping of the oranges during transport, so that a better price will be obtained for the fruit exported. In Surinam the oranges ripen from July to October, the months during which they are absent from the European market. As Surinam oranges are larger and of better flavour than European ones, they are much in demand on the Amsterdam and other inland markets.

The rules to be observed in sowing seed, care of the seedlings in the nursery, grafting, final plantation (in squares, 25 feet apart, or about 70 trees per acre), cultural methods, etc. are given.

The chief disease is gummosis, found in groves where the trees are too close together. The chief injurious insects are ants, which greatly damage orange trees, and scale insects, which attack particularly young nursery plants.

As the cultivation of orange trees is relatively recent in Surinam, it is too early to state which foreign varieties are to be recommended. Lambs Summer variety produces, in sandy soil, good fruit much appreciated in Europe, but which ripens a little late. The Washington Navel orange is good and less juicy than the native fruit. The Director of the Botanical Garden and the author have sought the best varieties for propagation among the native varieties.

A yield of 1000 fruit per adult tree is not exceptional. At Vredenburg; in 1911, a tree gave 3800 fruit. The average yield per tree may be fixed at 500 fruit. Estimating the sale price at $\frac{1}{4}$ d. per orange, an acre of 5 trees with an average of 500 fruit would bring in about £40; from this must be subtracted the cost of cultivation, placed at about £4.

The methods of packing are described, those used in California for shipping oranges being specially recommended.

- The Nigerian Lime Tree (*Citrus medica* var *acida*). - See No. 254 of this Review.

- The Cultivation of the Pistachio Tree. - See No. 254 of this Review.

- Hybrid Bearers in 1917 in France. - LÉVÉ-LABY, E., in *La Vie agricole et rurale*, Year VII, No. 32, pp. 103-106; No. 36, pp. 170-173. Paris, 1917.

In view of the ever increasing damage caused by cryptogamic diseases in the vineyards, the use of hybrid bearers becomes essential, and it is possible to plant them without hesitation. The principal hybrids, new and old, are described with special reference to their behaviour in 1917, especially in the author's experiment plot at Toulouse.

I. - BEHAVIOUR OF SOME OLD HYBRIDS. - Seibel Nos. 1020, 156, 128, 7. The attack of black rot which occurred during the first days of June had no serious effect on these four hybrids. There were a few patches on the leaves, and very little on the pedicel of the bunch. None of them spread on account of the prolonged drought and heat. Some French plants, such as *Ugais bleu* and *Grand noir* suffered rather badly in Bas-Languedoc; in Cognac some districts were seriously affected by this disease. Only in

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some badly exposed rows were blisters causing loss of grapes on the bunch of 1020, 128 and 156. These three hybrids gave excellent crops.

Mention must be made of 128 on account of its remarkable behavior in 1917, with goodsized fruit. The plants, which had been attacked by black rust two years before, and had given no harvest since then, gave particularly heavy crop without any treatment whatever. The two stocks which suit it best are 3306 and *Rupestis du Lot*. In the experiment plot at Toulouse it does as well direct as grafted.

As usual 1020 yielded well, perhaps better ungrafted than grafted. Except a few badly exposed plants which suffered from mildew and oidium they were all healthy with yields which varied according to the stock. In 1917, the stocks which appeared to suit it best were 34-E and 3306.

There is nothing of particular interest to be noted for 1077, which behaved as usual. It must be noted that this hybrid, known to be sensitive to black rot, showed no patches on the clusters as the others did. This is probably because it was grown in a more airy, sunny place with a better exposure.

These four hybrids have never been treated with sulphate or sulphur during the ten years since they have been planted. There is no doubt that had they been treated with copper or sulphur, they would not have suffered from the attacks mentioned, or only to a very slight extent.

Seibel 138: — An excellent plant, either direct or grafted. The late patches of mildew on its leaves never attack the grapes and do not prevent them from ripening; if it does not yield heavily it at least yields regularly.

Seibel 1003: — has never failed to give a crop of medium sized grapes; it suffers more from lime than from mildew.

Seibel 2: — always gives a regular and good yield; suffers very little from mildew; does well with *Riparia* as stock.

Seibel 1000: — did very well as in the preceding years, but lost part of its fruit as a result of black rust; the harvest was reduced by half; neither the soil nor the climate of the Toulouse Garden suit it; but it does very well elsewhere, especially in the south.

Seibel 1070: — does very well in good exposures; always has a heavy crop; suffers from oidium, but one or two good sulphurings protect it.

Couderc 7103: — has the same fault and needs the same treatment; gives a fairly good yield; not too sensitive to mildew.

Couderc 7104: — showed its usual good and bad qualities; lacks vigor when ungrafted and with most stock; it gives a small harvest but excellent grapes.

Couderc 7120: — always the same, suffers from no disease and gives an average, but regular, harvest; produces better in the south than in the south-west.

Couderc 4401: — its principal fault is that it suffers from oidium and black rust; in the author's garden, part of the crop is lost each year as a result of this last disease; elsewhere, if well tended, it produces well and without non-setting.

Girard 157: — white, is placed among the old hybrids because, in 1917,

of its faults, it is found everywhere at the present time; it is fairly liable to mildew and not resistant to oidium; in 1917, as in preceding years, the leaves which had not been sprayed with sulphate were attacked, but there was neither grey rot nor red rot on the clusters; it is in demand everywhere because if treated with sulphate and sulphur its heavy yield (about 9 to 13 lbs.) is assured.

It is seen that among these old hybrids are some good ones, which, in the absence of others, might be used, for 128, if well exposed, 156, and Nos. 2, 138, 2003, 1070 and 7120 always give relatively good yields, especially if treated once or twice with copper and sulphur. *Girard* and 1020 are now appreciated everywhere. There are, however, more recent hybrids which are justly considered superior to the preceding ones by reason of better grapes, a greater resistance, and absence of certain faults, recognised by those who grow them or make wine with them.

II. MORE RECENT HYBRIDS. — A. BLACK HYBRIDS. — (Untreated with copper and sulphur)

Seibel 753 : — has just a few small unimportant spots of mildew on its leaves, the grapes are intact, of good size, well-spaced; very regular.

Seibel 873 : — resists mildew well, did not suffer in 1917 either on the leaves or fruit, which is large, close and almost average.

Seibel 4121 : — remarkable for the resistance of its leaves and its clusters; the author has never seen the slightest sign of disease on it; bears a good crop, and, although its fruit is not very large it gives 13 lbs. or more per plant; neutral wine, strongly coloured, giving, in 1916, 9.60; strong plant, doing as well ungrafted as grafted; bushy.

Seibel 4643 : — only has a few negligible spots of mildew on its leaves; grapes intact, fairly long, not very close, excellent, sweet, giving a first class wine; rather similar to French plants.

Gaillard 194 : — completely immune to mildew in the Toulouse Garden; elsewhere it is said to suffer slightly from this disease; in the Toulouse garden it is more vigorous direct than grafted, and to such an extent that the grapes did not all set; must be carefully pruned to avoid loss of the many grapes; ripens early; wine much appreciated.

Jurie 580 : — has the appearance of a stock plant with hardy leaves; rarely subject to mildew; gives a heavy yield in good soils; very strong, does as well grafted as ungrafted.

Malègue 829-6 and 1551-2; liable to black rust which excludes them from certain damp districts; it may be protected from mildew by one or two sulphate sprayings; the second is rather later than the first; very good wine.

In this group of black grapes, *Seibel* 4121 and *Jurie* 580, are noted as particularly hardy; the two *Malègue* mentioned, as finer and almost equally good yielders.

B. PINK HYBRID : — *Seibel* 2859 *rose*; resistant to mildew without sulphate spraying; good yielder; good wine.

C. WHITE HYBRIDS. — This group includes plants valuable both for their resistance to disease and their produce.

Seibel 793 : — highly recommended on account of its great resistance

to all diseases ; if the grapes and seed are not very large, there is at least the certainty of an annual harvest, without non-setting, of good flavour, without the expense of copper or sulphur.

Seibel 850 : — less resistant than the preceding one, but can do without sulphate treatment in years such as 1917; resisted well in the author's experiment plot ; fruitful ; average clusters with average grapes.

Seibel 880 : — can, if necessary, do without sulphate spraying ; good and regular yielder, giving excellent grapes, but often below the average ; appears to be derived from 2 red parents — 28-112 and 2003.

Seibel 867 : — fine, cylindrical cluster, winged, fruit above the average, does not suffer from non-setting or other defects ; may be said to be immune to all diseases ; wine said to be slightly foxy, which is not surprising as the plant is descended from 2003 and *Noah*, but is much less foxy than wine from *Noah*.

Seibel 2653 : — valuable as a table grape in the absence of *Chasselas*, so long as it does not abort too much ; its chief fault in some years is liability to non-setting in certain districts ; not so subject to mildew as *Chasselas* and is satisfactorily protected against strong attacks by two or three sulphate sprayings ; fruit big, oval, and excellent, not subject to oidium.

Seibel 4773 : — like 793 it is immune to all diseases, but gives a higher yield ; its wood and veins are also red, especially when growth begins, longer fruit rather wider apart ; very sweet juice.

Seibel 3021 : — very slightly subject to mildew ; without ever having been treated with sulphate it lost no leaf through this disease ; grapes only average, or below the average, close-set and of good flavour, ripen in the second late period.

Seibel 4681 : — has still better foliage ; cannot do without copper and sulphur ; yield below the average because fruit is below the average ; wine of good flavour and alcoholic.

With the exception of No. 2653, which requires two or three sulphate sprayings, all the other white hybrids can do without sulphate. If they do not give a high yield of 22 lbs. per plant they give a regular average yield of good-flavoured grapes, except 867 which is slightly foxy, and a wine rich in alcohol which may be used either alone or mixed, and is of great value for blending wines.

Couderc 235-120 and 272-60 ; the first yields well and is easily protected ; the second is subject to oidium.

Malègue 1157-1 and 1897-12 ; do well in the Toulouse district with an average of two sulphate sprayings ; a fairly large quantity of grapes above the average, ripening in the second late period, excellent wine ; the first is slightly subject to mildew.

III. NEW HYBRIDS. — These hybrids have been grown *directly* in the experiment garden since 1914 ; they are at their third leaf. They have also been grafted on various stock, and put in next to the direct plants the following year. None have been treated with copper or sulphur ; the square on which they are grown is about 9 yards from a *Chasselas* vine which was sprayed four times and eaten up by mildew. Round the edge of the plot

are hybrids which lost almost their whole harvest through mildew, black rot and oidium. Although the hybrids of this collection are not entirely immune to disease, they suffer less than the older ones. Their relative resistance may be seen at a glance and an ascending or descending scale easily constructed. For the vine-grower their value lies in the comparisons which may be made between the relative quality of about 60 hybrids grown side by side under identical cultural conditions and without any treatment.

The most important are :

A. WHITE HYBRIDS: — *Seibel 4657*, direct ; large leaf, wide, with shallow lateral sinuses ; large widely-spaced, very pointed teeth at edges, more marked than those of the muscatel, dark green, dull ; internodes from 13 to 15 cm., green, not red ; bunches large, branchy, loose, with oval fruit above the average, fairly far apart, ripening at the end of the first period, of good flavour and very sweet ; may be regarded as a table and vat grape ; very fruitful ; does not appear to be subject to non-setting, and is, consequently, a good yielder ; with neither sulphur nor sulphate treatment it only had a few insignificant spots of mildew on some of its leaves.

Seibel 4986 : — direct ; very vigorous ; leaves with deep sinuses and rounded at the base, very large, very pointed shiny teeth, set far apart ; long internodes of 17 to 20 cm ; bunches, mostly winged, cylindrical-conical, with round, fairly close fruit, average or above the average, ripening at the end of the first period ; good flavour ; very productive, does not non-set, thus giving a good yield ; very resistant to mildew and oidium.

Seibel 4633 : — direct ; best yielder of the whole collection ; excellent leaf of an almost dark green, shining as if varnished ; lateral sinuses absent, those preceding the tip, fairly marked, giving the leaf a round appearance ; teeth fairly wide and regular, internodes 9 to 10 cm. long, of green, thick wood ; very fruitful ; bunches above the average with round fruit, above the average, close, ripening in the second period, good flavour, almost perfect resistance, subject to neither mildew, oidium, nor black rust.

Seibel 4603 : — direct ; the lower leaves are dark green and cut out like those of a fig tree, the sinuses being shallow but the teeth round them well marked ; internodes 9 to 10 cm. long of green wood ; clusters cylindrical or fairly conical, with round, average, close fruit of good flavour ; very resistant to mildew.

Seibel 4955 : — direct ; leaves have hardly any sinuses and appear round, of the green of *Rupestrif* and of average size ; internodes relatively short of 7 to 8 cm ; wood green ; very fruitful ; bunches cylindrical, usually above the average, with fairly close, round, average fruit ; a very few patches of mildew on the leaves.

Seibel 5279 : — direct ; leaf appears round and is only pointed at the base, where there are two shallow sinuses ; teeth few but fairly pointed ; tissue, lightly leathery as that of the Noah leaf ; internodes from 6 to 9 cm., good green ; very fruitful ; clusters average, rather long, wide at the base, above the average ; fruit close, round, average, ripens early, end of August, grape sweet, excellent, remains a long time on the bunch and is a good keeping grape ; strong resistance to oidium and mildew.

Seibel 4709: — direct; leaves long with normal sinuses, slightly pointed teeth, of a dark green colour; internodes fairly large, from 8 to 10 cm., wood green; very productive, clusters average, not very long, squat; grapes average or above the average, round, close, of excellent flavour; ripening during the first period; very resistant to disease, barely a few spots of mildew in autumn.

B. RED HYBRIDS. — *Seibel 4015*: — direct; leaves large and heart-shaped, without pronounced lower sinuses, teeth fairly prominent; wood of shoots green; internodes from 12 to 14 cm.; very fruitful and, on account of its average clusters with average, round fruit, very productive; ripens during the second period; foxy flavour, which is its only fault; remarkable resistance to disease.

Seibel 4565: — direct; leaf large, wider than it is high, round, no sinuses, large teeth; seems fairly hardy; wood green; internodes average from 8 to 9 cm.; very fruitful and productive; cluster conical, long, above average; fruit average, fairly close, round, ripening during the first period, slightly pulpy; fairly good resistance to disease.

Seibel 5145: — direct, average leaf, round, with appearance and red veins of the *Berlândieri* leaf, without well-marked teeth; wood red; internodes fairly long, 10 to 12 cm.; good producer; clusters above the average, long and sometimes winged, fruit average, round, juicy, ripening during the second period; excellent resistance to disease.

LIVE STOCK AND BREEDING.

304 — **Screw-Worms and other Maggots Affecting Animals.** — BISHOP, F. C., MITCHELL J. D. and PARMAN, D. C., in *U. S. Department of Agriculture, Farmers' Bulletin 857*, pp. 8 figs. Washington, September, 1917.

The screw-worm (*Chrysomya macellaria* Fabricius) is a native of America, and is found from the extreme south to Canada, but is rarely abundant in the Northern States, as the fly is quickly killed in cold weather. The states of North America which suffer most severely are Texas, Oklahoma, New Mexico, Arizona and Southern California.

Practically all animals are attacked by this insect. Probably cattle suffer most; hogs, horses, mules, sheep, goats and dogs follow in the order named. Wild deer (*Cariacus* sp.) and many of the smaller mammals are sometimes seriously infested. Human beings are also frequently attacked. The female lays its eggs in wounds or skin injuries, where the parasite remains throughout the larval stage. The pupa is usually found in the ground. A huge number of eggs may be deposited in a mass by a number of females. In livestock the parasite always causes loss of appetite and emaciation, and sometimes death. In some districts it makes calf-rearing almost impossible (the fly lays its eggs in the navel of the new-born calf often causing its death) and older cattle have to be bought elsewhere. In sheep it causes emaciation and decreased milk production, and in all cases involves increased expenses for the watching and treatment of animals.

The screw-worm fly is the only species in the south-west of the United States which penetrates the sound tissues of animals, but other flies attack diseased tissues of wounds and soiled wool. These flies are: — the black on fly (*Phormia regina* Meigen), green bottle fly (*Lucilia sericata* Meigen), and gray flesh flies (*Sarcophaga texana* Aldrich, *S. tuberosa* var. *sarracenioides* Aldrich, *S. robusta* Aldrich). All these flies breed in decaying animal matter, especially in carcasses of large animals. If all dead animals were properly disposed of no cases of infection of living animals would occur.

The best method of control is the burning of carcasses. This reduces the danger of infection by anthrax, tuberculosis and similar diseases in the pastures and prevents the breeding of flies in the carcasses. If it is not possible to burn the carcasses they should be buried, covered with quicklime especially if the death of the animal may be attributed to an infectious disease and then covered with at least 2 feet of soil.

Methods of controlling the parasite in cattle are: — avoidance of injury, drying at a time when the flies are not abundant (between December 1 and the middle of April, and, in the north, from November 1 to June 1), destruction of ticks, performance of surgical operations (castration, dehorning, etc.) in winter or the beginning of spring, poisoning and trapping the flies, to prevent the larvae from infesting the wool of sheep, lamb early and dip and clip soiled sheep. To avoid dehorning, hornless types may be bred. The animals must be continually watched so as to discover the first symptoms of infection, and the larvae killed with chloroform, the wounds being then treated with pine tar to repel the flies.

Appended is a list of 33 publications issued by the United States Department of Agriculture on insects affecting the health of man and domestic animals.

5 - **The Cause and Prevention of Hairless Pigs, in the United States.** — WELCH, HOWARD, in *Montana Agricultural College Experiment Station, Circular 71*, pp. 37-47, 9 fig. Bozeman, Montana, 1917.

It has been known for some years that, in certain of the Northwestern States, the new-born of all the domestic animals were in some way defective. New-born pigs were hairless and seldom lived; the calves were often hairless and more frequently had goitre. The young of sheep and goats were similarly affected, while new-born foals, though neither hairless nor having goitre, were weak, seldom able to stand and usually died.

In Montana, the loss is probably heaviest in young pigs, for about 6000 are estimated as dying from this cause annually. In some localities pigs are the only domestic animals affected, while in others, it may be lambs only. It is a disease of definite localities, occurring in Montana in the drainage basin of the Yellowstone, the lower Missouri, the Musselshell and some of the smaller tributaries; outside this zone, a number of scattered cases constitute about 5 % of the total loss. In some cases, the pig crop can be saved on moving the pregnant sows a mile or two out of the affected district during gestation. The malady varies curiously: one year it may cause 60 % loss, and nothing the year after. There are also variations in a sin-

gle pen of pregnant sows. Pigs born in March and April are more often affected than those born in May and June, while autumn-born pigs are frequently normal even in badly affected districts.

Amongst causes of the trouble have been suggested: — contagious abortion; alkali in the soil; some particular feed, such as alfalfa, flax, maize, or wheat; or some deficiency in the soil or water. All these causes have been studied by the author, but negative results were always obtained.

Post-mortem examinations showed: — that the hairless pig has a thick, pulpy skin, especially round the head, neck and shoulders; that the thyroid gland was very hypertrophied and the heart not fully developed. The development of goitre and the hairless condition are of related gravity. This leads the author to suppose that goitre was the cause of the disease, and he found by analogy with human goitre, that the hypertrophied thyroid glands contained much less iodine than the normal quantity, or even none. He therefore concluded that the cause of the malady is lack of iodine in the food and water given to the animals, and that it was worth testing whether this insufficiency could be compensated for by giving potassium iodide. Tests made with pigs (with 129.5 to 324 mgm. of potassium iodide per head per day) with female breeding stock during gestation, gave positive results. Iodide of potassium given to a pregnant female prevents goitre appearing in the newborn. Therefore, it is advisable to feed iodine to pregnant animals in regions where goitre is prevalent.

36 — **Iron as an Antidote to Cottonseed Meal Injury** (1). — WITHERS, W. A. and CARROLL, FRANK, F., in *The Journal of Biological Chemistry*, Vol. XXXII, No. 2, pp. 215-227, 4 diagrams. Baltimore, November, 1917.

Experiments carried out at the Chemical Division of the North Carolina Agricultural Experiment Station, West Raleigh, showed that, though rabbits are very sensitive to poisoning by cottonseed meal (obtained by extraction of the oil by solvents) even when it has been cooked a long time, they could be successfully fed with this meal for a long period (the experiment lasted 106 days) if it were mixed with ferric ammonium citrate. The authors extended these experiments, using pigs as subjects, in order to investigate whether the harmful action of cotton seed meal is due to an injurious substance or, as some assert, to inadequate or badly proportioned diet.

Although the addition of iron salts is not to be recommended as a practical method for overcoming cottonseed meal poisoning, the experiments show that, when such salts are present, much larger quantities of the meal may be fed, with a resulting increase in body weight; in some cases it was even possible to prevent death, in many, to retard it. Further evidence of the presence of a toxic substance in the meal is the fact that extracted with alcoholic alkali removes the toxicity (experiments with rabbits). The authors assume the loss of toxicity to be due to: — 1) the formation of an insoluble iron salt of gossypol or one of its derivatives; 2) the catalytic

(1) See also *E.* January, 1918, No. 64. (*Ed.*)

celeration of the oxidation of gossypol; 3) perhaps a tonic action on iron.

When cottonseed meal is treated with iron salts it turns brownish black, proving that a reaction takes place with some component of the meal. The action of iron salts on a solution of gossypol produces a similar colour. The fact that the effects of the toxic factor may be inhibited by the action of iron salts shows that the toxicity of cottonseed meal is not due to a lack of "vitamines" or to a deficiency in calcium, sodium and chlorine, as might be expected from the chemical analysis of a diet of maize and cottonseed meal.

It is interesting to note that, in the authors' experiments, wood ashes had no antidotal action in preventing the death of pigs fed on maize and cottonseed meal, but the animal receiving ashes made much better gains, probably because of the improvement in the inorganic part of the diet. The appended table gives the results of one of the four experiments. In each of the four experimental groups were 9 pigs fed with a mixture of 25 % cottonseed meal, and 75 % maize meal. To each 4 lbs. of feed the control group (in which no iron salts were given) received 1 gallon of water, group 2, 1 gallon of copperas solution (1 lb. $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ dissolved in 30 gallons of water), group 3, 1 gallon of ferric chloride, containing approximately the same amount of iron as the preceding solution; group 4, 1 gallon of water with hardwood ashes *ad lib*. The experiment lasted 64 days.

Effect of the addition of iron to a diet composed of 25 % cottonseed meal and 75 % maize meal.

Group	Feed	Weight (in lbs.)			Cottonseed meal eaten	Deaths (among 9 animals)
		Initial	Final	Daily gain		
1	Control	103.4	107	0.05	47	6
2	Copperas	92.1	134.6	0.16	66	3
3	Ferric chloride	102.2	163.2	0.68	81	1
4	Hardwood ashes	98.3	137.7	0.67	50	7

7. **The Poisonous Properties of the Two-Grooved Milk Vetch (*Astragalus bisulcatus*).**—BEATH, O. A. and LEHNERT, E. H., in the *University of Wyoming, Agricultural Experiment Station, Laramie, Wyoming, Bulletin No. 112*, pp. 58-67, 1 fig. Laramie, January, 1917.

As *Astragalus bisulcatus* is not mentioned as a poisonous plant, the above bulletin gives an account of it to warn stockmen of its poisonous nature, grows in plains and valleys in the Rocky Mountain region. Milk vetch possibly most dangerous when fully mature but, when dry (as hay), it seems more or less harmless. Experiments carried out at the Wyoming Agricultural Station have led to the conclusions given below.

Milk vetch is certainly poisonous to cattle; its effect upon sheep is

uncertain; 80 to 90 % of the animals affected die. Water easily removes the active poison from green or air-dried material. All parts of the plant contain poison, with a slight excess in the leaves. The poison is neither precipitated by basic acetate of lead nor decomposed at 100° C.; it loses its toxicity on boiling with dilute acids, indicating its probable glucoside character, as does the fact that a crystalline substance has been isolated giving reactions of glucosides; at any rate, it is non-alkaloidal.

Thus far no chemical antidote has been found. When sufficient poison to cause death is introduced into the system, whether through the stomach or intravenously, it is quickly absorbed and soon produces symptoms of paralysis, by its action on the nervous system; the action of the heart is also interfered with, and the poison no doubt kills by acting on this organ; therefore drugs that stimulate the heart and the nervous system (alcohol, aromatic spirits of ammonia, belladonna extract, tincture of digitalis) should prove beneficial; these remedies should be preceded by a draught of 1 to 2 lbs. of Epsom salts.

308 - **Experiments on the Reported Poisonousness of Wild Melon Fruit.** — DODD, S. H. M., in *The Agricultural Gazette of New South Wales*, Vol. XXVIII, Pt. 2., pp. 815-817, Sydney, November 2, 1917.

Many Australian stock-owners believe the fruit of the wild or "paddy melon" (*Cucumis myriocarpus*) to be poisonous to livestock, causing injury to the nerves and blindness. The green part is also said to be harmful, but because it is indigestible rather than poisonous. In South Africa this fruit has been reported as poisonous to sheep and, in one case, as having caused the death of a child. Both in Australia and South Africa several feeding experiments have been made in which the wild melon was fed to animals, but contradictory and inconclusive results were obtained, because the fruit was eaten for a short time only, and as the disease it causes is chronic, it results only after it has been fed for a prolonged period. The ripeness of the fruit must also be taken into consideration, as some stock-owners assert that it is injurious only before it is ripe. In some districts the drovers gather the fruit to give to their horses.

The author carried out two series of experiments in which wild melon fruit was fed to guinea-pigs, two rabbits, a sheep and a horse. Two of the guinea-pigs, fed on unripe fruit, died, the other guinea-pig and the rabbits, after eating the fruit for about a month remained healthy and normal. The sheep was forcibly fed with the fruit for 20 days without showing any sign of poisoning; on the 21st. day it was asphyxiated through the carelessness of the attendant. The horse was fed for 51 days with wild melon mashed up with bran, in amounts of about 2 lbs. 2 oz. per day, then about 4 1/4 lbs. per day. It showed no sign of disease.

It seems as if the ripe fruit of wild melon may be considered harmless but the author does not consider his results conclusive and intends to continue the investigations.

309 - **Pyotherapy in the Treatment of Harness Wounds ; Some Considerations on the Efficacy and Absolute Non-Specificity of Anticryptococcal Pyotherapy on the Horse.** — VELU H., in the *Bulletin de la Société de Pathologie exotique*, I, Vol. X, No. 10, pp. 901-903. Paris, December, 1917. — II. Vol. XI, No. 1, pp. 12-17. Paris, January, 1918.

I. — In the course of researches on the pyotherapy of epizootic lymphangitis (1) the author has repeatedly found how efficacious is treatment with polyvalent vaccines (either anticryptococcal vaccine, or vaccine prepared from ordinary suppurations) for curing *non-specific* lesions, caused by harness.

During the negative phases, the peripheral inflammatory reaction becomes intense; the separation furrow forms more quickly; the necrosis issue is eliminated more easily, on account of the increased suppuration; surgical intervention becomes more easy, and the wound clears up without useless decay. During the positive phases, the wound cicatrises almost without suppuration, with surprising regularity and quickness. Local antiseptic treatment becomes almost accessory.

The author states that he has, by means of pyotherapy, rapidly cured arthritis and a severe traumatic synovitis, as well as obstinate bony fistulae. LIGNIÈRES (Bacteriotherapy in the treatment of Wounds, *Bulletin de la Société Centrale de Médecine Vétérinaire*, 1915, pp. 544-548) has already pointed out that specific organisms are not the only ones that give good results when injected into sick subjects. An antianthrax vaccination may stay the spread in a herd of a disease in no way connected with anthrax; wounds that wont heal may do so after injection of an organism unconnected with the disease, such as *B. coli*. On the other hand it is well known that the injection of any antigen is followed by a hyperleucocytosis.

In conclusion, pyovaccine provides a very efficacious, simple and economic method within the reach of all practitioners, for reducing, in considerable proportions, the time lost in laying-up for harness wounds.

II. — The polyvalent anticryptococcal pyovaccine prepared at the Casablanca Laboratory has been used for treating pyogenous lesions of the horse due to pathogenic agents other than the cryptococcus. The results clearly showed the definite action of the pyovaccine.

In every case, the injections brought about decreased local inflammation, less pain, the diminution, then disappearance, of suppuration, and in certain cases, sterilisation of the lesions. Their non-specific effect is un doubted, even when they do not bring about complete recovery.

The author quotes work of other experimenters on other vaccines, showing their non-specific action, and he concludes, speaking generally, that polyvalent, paraspecific pyotherapy is a very simple and economical method which, whether by results already obtained, or those rightly expected, should take a prominent place in the practice of veterinary therapeutics.

(1) See R., July 1917, No. 611; R., August 1917, No. 734; R., February 1918, No. 176; and No. 310 of this Review (Ed.)

- 310 - *The Curative Treatment of Epizootic Lymphangitis by Vaccinotherapy; Preparation of a Polyvalent Pyovaccine.* - I. VELU, II., in the *Recueil de Médecine Vétérinaire publié d'Ecole d'Alfort*, Vol. XCII, No. 9 and 10, pp. 195-204. Paris, 1917. - II. IDEM, in the *Bulletin de la Société de Pathologie Exotique*, Vol. X, No. 8, pp. 681-684. Paris, 1917. - III. IDEM, in *Ibid.*, Vol. XI, No. 1, pp. 10-11. Paris, 1918.

Work carried out at the Research Laboratory of the "Service de l'Élevage du Maroc" at Casablanca.

I. - The vaccine is obtained from pus from diseased horses and is, thus, an "antieriptococcal pyovaccine". The subcutaneous injection causes, more or less rapidly, a reaction of the organism shown by very clear clinical signs at the level of the specific lesions. First appears a *negative phase* (aggravation of all the symptoms), which is then replaced by a *positive phase*.

The question of treatment consists in finding out suitable doses, and the frequency of renewal, so as to cause insignificant negative phases and predomination of positive ones.

The author gives results obtained with sick horses, and describes the broad lines of his method, which has given excellent results.

II. - After new clinical observations on over 100 animals for over 6 months, the author, having slightly modified his method, gives the final technique as follows: -

1) Injections of pyovaccine cause a reaction with effects localised at the level of the lesions. There is a negative phase. Therefore, all lesions containing pus should be punctured from the start.

2) Subcutaneous injections of pyovaccine sometimes cause abscesses that heal slowly; for this reason, intravenous injections are advised, as giving quicker and more certain results.

3) The first 2 injections of pyovaccine, and especially the second, in strong doses (4 to 6 cc. for the first, 1.5 to 2.5 cc. for the second), produce intense and lasting positive phases. The doses should, in consequence, be strong and separated by intervals of 8, 10 or even 12 days. The giving of another injection should be delayed until the moment when the positive phase begins to slacken, that is, when the improvement begins to decrease, but one should not wait longer than this.

4) After the second injection the organism is very sensitive. So, after the third injection, small doses of pyovaccine (0.75 to 1.25 cc.) must be given. Fresh injections should be given immediately the positive phase begins to weaken, i. e., about every 5, 6, 7 or 8 days.

The author states that the effects of pyovaccination are not strictly specific, and that he has obtained, with antieriptococcal vaccine, excellent results in the treatment of obstinate fistulae or of considerable lesions that did not show the causal organism of epizootic lymphangitis.

III. - *Polyvalent* vaccines and serums are those that act against several species of organisms, and *polyethnic* vaccines and serums are those that act against several varieties of the same species. Under these conditions, pyovaccine prepared with products obtained from several horses suffering from epizootic lymphangitis, is a polyethnic antieriptococcal pyovaccine, for it solely contains cryptococci of different strains. In the open lesions

e disease there are, besides the cryptococcus in abundance, numerous abundant associations of bacteria that certainly play no unimportant part; a polyvalent pyovaccine can thus be prepared which will act both on cryptococci and associated organisms.

The technique for preparing the vaccine is as follows: Remove the pus from closed lesions by means of a sterilised syringe, after cutting the hair and disinfecting the skin over the abscess; also remove with the syringe the pus or serosity collected at the surface of open lesions, under the crusts covering them; read off the volume on the graduated syringe and empty into a sterilised flask containing a known quantity of ether and phenolated physiological serum at 5‰; mix well by shaking; mix together the pus obtained from several cases; add the quantities of ether and 5‰ phenolated physiological serum required to bring the vaccine to the ratio of 1 of pus to 5 of ether and 10 of phenolated physiological serum; filter through 6 sheets of sterile gauze.

The vaccine thus obtained will be a polyvalent antipyrogenous vaccine treating, not only epizootic lymphangitis, but also varicous pyogenous lesions of the horse.

1 - **Pyotherapy in Epizootic Lymphangitis; Researches in Italy.** — LANFRANCHI, A. and BARDELLI, P., in *Il Moderno Zootetra*, Series V, Year VI, No. 12, pp. 261-275, diagrams 7. Bologna, December 31, 1917.

After summarising the work carried out by MANGAN, BELIN and MU (1) on pyotherapy, the authors give a detailed description of their treatment of epizootic lymphangitis by means of pyotherapy, which has given completely negative results. "In all the animals treated, whether the lesions were slight, of moderate severity, or severe, the 2 series of 6 injections (each of 2 cc. of pyovaccine) with an interval of 8 days, caused no diminution of the progress of the disease"; even with subjects used as controls, during the experiment, it was found that the injections of pyovaccine "have accelerated and aggravated the disease". Therefore, according to the authors, at the present state of our knowledge, autotherapy and pyotherapy are not methods of treatment the use of which could be advised in epizootic lymphangitis.

2 - **The Vitality of the Rinderpest Virus Outside the Animal Body under Natural Conditions.** — SMITHSON, A. W., in the *Memoirs of the Department of Agriculture in India*, Veterinary Series, Vol. III, No. 1, pp. 32 + IV plates. Calcutta, October, 1917.

Great uncertainty has existed in regard to the length of time that rinderpest can exist outside the animal body, either under natural conditions or when special measures are taken to preserve its vitality. On this account, the experiments described in the present Memoir, were designed to ascertain the duration of the vitality of the rinderpest virus 1) on ground in the open air, 2) in closed sheds, 3) in faeces, urine and mucous discharges, and in meat, blood and bones under varying natural conditions. To make the

(3) See also R., 1917, No 734; R., February 1918, No 177 and 178. (Ed.)

tests as complete as possible, they were carried out both at the Muktesar Laboratory, 7 500 feet above sea-level, and, save the last one, at Barwell under plains conditions. The author condenses the results obtained, which are described in detail, into the following general conclusions:—

At the Muktesar Laboratory, rinderpest infection was found to persist in certain buildings for 48 hours after the removal of the sick animals, but not for longer periods; frequently infection was absent after shorter intervals. Shaded ground, when contaminated by cattle suffering from rinderpest, was found to be infective to healthy stock 18 hours after the removal of the sick animals, but not after longer intervals. Ground entirely exposed to direct sunlight did not remain infective beyond 8 hours.

In the plains, buildings were found to remain infective for 20 hours after removal of the sick animals, but were non-infective after longer intervals. Shaded areas remained infective for 24 hours and those exposed to direct sunlight for 6 hours after removal of the sick animals, but not longer periods of time.

The rinderpest virus was found to survive in mixed faeces and if protected from direct sunlight for periods up to 54 hours after excretion by sick animals, but when exposed to sunlight the virus did not survive more than 8 hours. Saliva and nasal discharge from sick animals did not remain infective beyond 44 hours.

It may thus be concluded that, in buildings and areas infected by the natural discharges of sick animals, the rinderpest virus is unable to survive for more than 2 or 3 days, and when air and sunlight are freely admitted destruction is even more rapid.

The carcasses of animals that have died from the disease must, however, be regarded as possible sources of infection for some considerable time after death, especially when the air temperature is low, as it has been shown that the virus can survive for 51 days in blood from a sick animal even when this has been freely exposed to the air and allowed to become putrid. In meat and bones also the virus may persist for many days.

313—**Tuberculosis in Camels, in Egypt.**—MASON, F. E., in *The Agricultural Journal of Egypt*, Vol. VII, pp. 6-11, Plates. Cairo, 1917.

Tuberculosis appears rarely to affect camels outside Egypt, but in this country it has long been known. In 1911, 1.63 % of the camels slaughtered at the Cairo abattoir were found to be tuberculous, while for 1915 the percentage was 5.4. These figures are certainly higher than those for the entire infection in Egypt.

The author ascertained the cause of the disease by identifying the causal bacillus; controlled by inoculations in guinea pigs. The bacillus appeared to be of the bovine type.

(1) In view of the statements made by various authorities that the rinderpest virus does not survive in drawn blood more than a day or two, it may be mentioned that in a very large number of observations made at the Muktesar Laboratory, defibrinated blood stored under aseptic conditions at room temperature remained virulent for from 30 to 40 days and in one case, blood kept at 0°C. was virulent after 90 days. [Author].

The author thinks that infection takes place primarily from cattle, the method being by inhalation. About 60 % of the tuberculous camels are only affected in the lungs, bronchial and mediastinal glands. The disease is never found in camels from countries where they do not come in contact with cattle. The subcutaneous test with ordinary tuberculin can be successfully employed on suspected camels.

14 - **Animal Calorimetry: The Interrelation Between Diet and Body Condition and the Energy Production during Mechanical Work.** — ANDERSON, R. J. and LUSK, GRAHAM (Physiological Laboratory, Cornell University, N. Y.), in *The Journal of Biological Chemistry*, Vol. XXXII, No. 3, pp. 421-435 + 10 tables. Baltimore, December, 1917.

Previous work on this subject showed that the heat produced by a given quantity of mechanical work was the same whether a man were fasting or had partaken liberally of a mixed diet (VOIT, 1866). Other experiments on men have shown mechanical work to be more easily performed after ingestion of saccharose than after ingestion of meat. This led to the conclusion that there is a summation of the two energy increments due respectively to work and food ingestion (RUBNER, 1910; BENEDICT and MURCHHAUSER, 1915).

The authors extended these experiments to the dog, in which dietary control is easier than in man. The experiments dealt with the influence of meat or glucose ingestion upon the heat production of a dog running at the rate of about 3 miles an hour; and the influence of fasting upon the quantity of energy required to do a given amount of mechanical work.

METHOD. — A treadmill with a moveable platform was specially constructed to permit of the use of the Williams calorimeter (described by the designer in *The Journal of Biological Chemistry*, Vol. XII, p. 371; 1912). This calorimeter is a breathing apparatus specially designed for experiment on small animals; it is based on the REGNAULT type of calorimeter, improved and supplied with triple walls which allow very close observation of the slightest changes in temperature. Each revolution of the wheel operating the treadmill represents a forward movement of 0.458 m., and every 1 000 revolutions produce 0.5 calories by friction in the box of the calorimeter. The speed was kept constant during each hour of the experiment. The "standard diet" given was composed of 100 gm. of powdered biscuit, 20 gm. of lard, 100 gm. of beef; to this daily ration were added 10 gm. of bone ash. (GRAHAM LUSK, Animal Calorimetry, *Journal of Biological Chemistry*, vol. XIII, p. 185, 1912-1913). The basal metabolism was determined 18 hours after the administration of the standard diet when the dog was resting in the calorimeter at a temperature of 20°C. In the first series of experiments the basal metabolism was 17.5 calories per hour, and in a second series, where the average of the different hours was calculated, it was 17.2 calories.

INFLUENCE OF MECHANICAL WORK 18 HOURS AFTER INGESTION OF STANDARD DIET. — The quota of heat production due to muscular activity was found by subtracting the basal metabolism from the total metabolism determined during the work. The results given in Table I A. show that, 5 hours after ingestion of the standard diet, a dog weighing about 9 kg.

covering a distance of 3.9 to 4.8 km. per hour, did this work with an expenditure of energy equal to 0.580 kilogrammeter (to move 1 kgm. 1 meter). Although the weight of the dog varied 17 % during the experiments, and the speed of the treadmill 20 %, the maximum difference in energy expended was 1.7 %. (It will be seen that there is a relation between the weight of the animal and the energy required to move its body horizontally; a 15 % gain in weight caused a corresponding gain of 15 % in the energy requirement).

TABLE I. — *Influence of mechanical work.*

Date (1917)	Food gm.	Experi- ment No.	Weight of dog	Indirect calori- metry (cal.)	Respi- ratory quotient	Work in meters trav- elled	Calories above the basal per 1000 meters travelled	Kilogram- meters required
<i>8 hours after ingestion of standard diet.</i>								
A January 5	—	2	8	60.8	0.78	3 925	11.0	0.583
Feb. 28	—	8	9	70.0	0.81	4 300	12.3	0.583
March 13	—	18	8.9	74.8	0.75	4 688	12.2	0.583
" 23	—	24	9.2	76.7	0.74	4 717	12.6	0.571
" 27	—	27	9.4	76.7	0.81	4 718	12.6	0.571
"	—	13	9.0	76.1	0.79	4 806	12.2	0.573
<i>During the hours immediately following ingestion of glucose.</i>								
B January 5	Glucose, 70	3	8.35	62.3	0.98	3 936	11.1	0.579
March 15	Glucose, 70	19	9.6	77.1	0.92	4 771	12.5	0.553
" 26	Glucose, 100	26	9.7	76.8	0.95	4 737	12.5	0.553
<i>4 or 5 hours after ingestion of meat.</i>								
C January 11	Meat, 700 gm.	6	9.25	82.1	0.82	4 101	15.8	0.70
March 6	No food.	13	9.0	76.1	0.79	4 806	12.2	0.57
" 12	Meat, 750 gm.	17	9.6	92.4	0.80	4 704	16.0	0.70
" 10	Meat, 750 gm.	16	9.5	* 30.6	0.80	—	—	—

* Dog resting.

INFLUENCE OF MECHANICAL WORK DURING THE HOURS IMMEDIATELY FOLLOWING THE INGESTION OF GLUCOSE. — The same dog after the ingestion of 70 or 100 gm. of glucose in water did the same amount of work with an energy expenditure of 0.550 kilogrammeters (see Table I B.) Thus, to supply the same amount of mechanical work, the dog, immediately after the ingestion of glucose, requires about the same amount of energy (slightly

ss) than when it does the work 18 hours after ingestion of the standard diet. It may, however, be said that, in spite of the addition to the weight of the dog of the aqueous solution ingested which increased the total weight to be displaced, the expenditure of energy was only 0.550 kilogrammeters; this figure, compared with the preceding one (0.580 kilogrammeters), shows that the ingestion of carbohydrates diminishes the energy required for a given piece of work by 5 %.

INFLUENCE OF MECHANICAL WORK 4 OR 5 HOURS AFTER THE INGESTION OF MEAT. — The results obtained after the ingestion of meat (see Table I C.) are in perfect agreement with those found by RUBNER in his experiments on man referred to above. The dog, 4 or 5 hours after the ingestion of meat, accomplished the work with an expenditure of energy exceeding the basal metabolism; this energy results from the sum of the specific dynamic action (1) of meat + the energy necessary for the work, the total being equal to an average of 0.587 kilogrammeters.

The ingestion of alanine (20 gm.) gives similar results, *i. e.* an energy expenditure resulting from the specific dynamic action of the substance and the work supplied.

TABLE II. — *Influence of mechanical work upon metabolism in fasting.*

Date (1912)	Experi- ment No.	Weight (kg.)	Days of fast	Indirect calori- metry (cal.)	Respi- ratory quotient	Work in meters trav- elled	Calories above the basal per 1000 meters travelled	Kilogram- meters required
March 29	28	8.75	3	73.7	0.71	4 796	12.06	0.584
30	29	8.6	4	16.0	0.74	—	—	—
31	30	8.55	5	70.2	0.724	1 719	11.5	0.570
April 2	31	8.35	7	15.0	0.74	—	—	—
3	32	8.1	8	14.3	0.715	—	—	—
5	33	8.2	9	70.8	0.710	* 5 023	11.2	0.587
9	34	7.6	13	12.4	0.75	—	—	—
"	—	—	13	62.7	0.717	* 1 710	10.0	* 0.505

* Average = 0.584 kilogrammeters.

INFLUENCE OF MECHANICAL WORK DURING FASTING. — The dog having lost about 20 % of its weight after 13 days' fasting, performed the same mechanical work with an average expenditure of energy of 0.584 kilogram-

(1) Term used by RUBNER to express the loss of energy peculiar to certain foodstuffs caused by the changes they undergo in the organism. (See B. 1911, p. 435, ZUNTZ, N. *Experiments and Points of View in the Study of Animal Metabolism with the Aid of the Respiratory Apparatus.* (Ed.)

meters (see Table II). If the results obtained during fasting are compared with those obtained when the animal is in the best nutritive condition (see Table I) it is seen that, to accomplish the same amount of work, the same expenditure of energy is required in both cases, in spite of the fact that, in the first, the dog has lost 20 % of its weight.

CONCLUSION. — To move 1 kilogram of body substance 1 meter through space the animal requires a *constant* expenditure of energy (0.580 kilogram-meter on the average), *independent* of its weight and of the specific dynamic action of the foods ingested. Only an abundant supply of glucose reduces slightly this expenditure.

315 - **The Effect of High Temperature on the Nutritive Value of Foods.** — HOGAN, ALBERT G., in *The Journal of Biological Chemistry*, Vol. XXX, No. 1, pp. 115-125, 6 diagrams. Baltimore, May, 1917.

The experiments described were made on rats in the Department of Chemistry of the Kansas Agricultural Experiment Station, Manhattan.

In a previous paper (*Journal of Biological Chemistry*, Vol. XXVII, p. 193, 1916) the author showed that young rats are unable to grow on a diet that has been subjected to high temperatures. Many investigators believe the so-called accessories to be destroyed by exposure to heat. In order to verify this hypothesis the author undertook new experiments, using as food maize and a mixture of maize and white of egg, one or both of which had been heated in the autoclave for 6 hours under a 30 lbs. pressure. It was found that heat had little or no effect on the white of egg, but that each time the maize was heated the diet became inadequate in some respect. To ascertain whether the protein had been changed, a relatively pure protein — white of egg — was heated in the autoclave for 6 hours at a 30 lbs. pressure. This protein was carefully dried and mixed with protein-free milk, butter, starch and agar in such proportions that the protein formed about 9 % of the ration. In further experiments, for the white of egg was substituted unheated casein (control) and casein heated in the autoclave for 2 hours under a pressure varying from 15 to 45 lbs. It was seen that the action of heat caused no essential modification of the food value of either the white of egg or the casein.

The author concludes that heating such as carried out in his experiments does not materially decrease the food value of proteins. The hypothesis that one or more of the so-called food accessories may be injured by high temperatures seems justified.

316 - **The Supplementary Dietary Relationship between Leaf and Seed as Contrasted with Combinations of Seed with Seed.** — MCCOLLUM, E. V., SUMMONDS, N. and PIZZ, W., in *The Journal of Biological Chemistry*, Vol. XXX, No. 1, pp. 13-32 + 14 diagrams. Baltimore, May, 1917.

At the Agricultural Station of Wisconsin, Madison, the authors had previously carried out a series of preliminary feeding experiments with a number of natural foods of one variety completed by the addition of one or more isolated and chemically pure dietary factors (protein, mixture of

inorganic salts, fat-soluble A, water-soluble E*). In this way they studied wheat (1) maize (2), rice (3), oat kernels (4) and white beans (5).

With the exception of polished rice and beans these seeds resemble each other closely in their dietary properties: — a) the proteins are of relatively, poor quality furnishing certain essential amino-acids in amounts below the optimum; b) the content and composition of the inorganic portion of each seed are of a character which cannot induce normal growth and must be corrected by certain salt additions; c) the content of the fat-soluble A is inadequate to supply the needs of a growing animal over a prolonged period. Unpolished rice closely resembles the other seeds mentioned above, but polished rice, which has lost both its bran layer and its germ, is deficient, not only in the above-mentioned factors, but also in water-soluble B. The common bean differs from the other seeds particularly in the poor quality of its proteins. These contain but little of one or more of the essential amino-acids, so that beans should always be combined with other natural foods capable of supplying the proteins which supplement this deficiency.

In the paper under review the authors give data obtained recently which clearly show the general lines along which successful nutrition may be obtained when the diet is purely vegetarian. Their experiments, which have lasted over 10 years, carried out with rats and pigs, convinced them that these two species have essentially the same food requirements. Neither species can grow satisfactorily when restricted to one of the cereal grains; as regards growth and reproduction both respond in the same way to specific modifications of a diet thus restricted. In the experiments described, made with rats, it was found impossible to make up a ration derived solely from the seeds of plants capable of giving normal nutrition during the growing period, even though two to five seeds of widely different varieties were employed. When the animals were put on a simple and unvaried diet of a mixture of leaves (alfalfa) and seeds, very different results were obtained.

• It was impossible to secure appreciable growth with the following mixtures of seeds with salt-free water.

- 1) maize 90, flaxseed oil meal 10;
- 2) wheat 20, maize 20, rolled oats 20, hemp seed 20, millet seed 20;

(1) HART, E. B., McCOLLUM, E. V., STEENBOCK, H. and HUMPHREY, G. C., *Wisconsin Agricultural Experiment Station Research Bulletin* 17, 1911; HART and McCOLLUM, *Journal of Biological Chemistry*, Vol. XIX, p. 373, 1914; HART, E. B., MILLER, W. S. and McCOLLUM, E. V., *ibid.*, Vol. XXV, p. 239, 1916; McCOLLUM, E. V., SIMMONDS, N. and PITZ, *ibid.*, Vol. XXVIII, p. 211, 1916-1917. — (2) HART and McCOLLUM, *Journal of Biological Chemistry*, Vol. XIX, p. 373, 1914; McCOLLUM, SIMMONDS and PITZ, *ibid.*, Vol. XXVIII, p. 153, 1916-1917. — (3) McCOLLUM, E. V. and DAVIS, M., *Journal of Biological Chemistry*, Vol. XXIII, p. 181, 1915. — (4) McCOLLUM, SIMMONDS and PITZ, *Journal of Biological Chemistry*, Vol. XXIX, p. 341, 1907. — (5) McCOLLUM, SIMMONDS and PITZ, *Journal of Biological Chemistry*, Vol. XXIX, p. 327, 1917.

* See also B. March, 1915, No. 296.

• For the explanation of these terms see R. Jan., 1918, No. 2.

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- 3) wheat 25, maize 25, rolled oats 25, hemp seed 25 ;
 4) wheat 33, maize 33, rolled oats 33.

These rations represent two distinct types; rations 1 and 2 promote good growth if suitable inorganic salts are added, but not otherwise; ration 3, after a period of suspended growth, responds less well to the addition of salts in its effects than the two preceding rations; ration 4 does not support growth. This shows that rations 1 and 2 contain a sufficient quantity of the factors fat-soluble A and water-soluble B, as well as proteins of adequate quality and enough assimilable energy as carbohydrate and fat. The preceding experiments (described above) showed that maize, wheat and oats contained an insufficient amount of the fat-soluble A, and it is, therefore, evident that flaxseed meal and millet seed contain a much greater

Inorganic constituents of vegetable foodstuffs (per cent.)

Vegetable	Ash	K	Na	Ca	Mg	P	Cl
<i>Leaf</i>							
Alfalfa hay	7.38	1.64	0.01	2.14	0.22	0.34	0.29
Rape green	8.08	2.23	0.23	1.26	0.18	0.49	0.61
Red Clover	6.86	1.84	0.10	1.71	0.45	0.29	0.26
Rhubarb	14.49	7.14	0.55	1.04	—	0.93	0.77
Spinach	16.48	2.27	4.32	1.40	0.63	0.74	1.04
Cabbage heart	10.85	2.51	0.80	1.66	0.23	0.71	0.75
<i>Seed</i>							
Hulled rice	0.39	0.07	0.016	0.009	0.026	0.09	0.00
Maize	1.55	0.32	0.05	0.01	0.12	0.33	0.045
Wheat	2.08	0.50	0.02	0.04	0.14	0.40	0.06
Oatmeal	1.83	0.36	0.06	0.01	0.09	0.38	0.10
Beans	3.63	1.25	0.03	0.13	0.16	0.61	0.00
Cottonseed meal (extracted with solvents).	7.48	1.85	—	0.23	0.68	1.50	0.00
Linseed meal (extracted with solvents).	5.84	1.18	0.07	0.35	0.55	0.80	0.04
<i>Tuber or root.</i>							
Potato	3.79	1.91	0.08	0.07	0.11	0.28	0.13
Sweet potato	3.07	1.28	0.15	0.22	0.06	0.11	0.39
Beet	5.97	0.84	2.16	0.25	0.01	0.25	0.29
Turnip	8.01	3.02	0.58	0.60	0.18	0.14	0.40
<i>Fruit</i>							
Oranges	3.08	0.93	0.31	0.54	0.15	0.15	0.07
Apples	1.44	0.43	0.28	0.04	0.07	0.08	—
Plums	2.08	1.20	0.03	0.06	0.06	0.12	0.00
Raisins	2.86	1.10	0.16	0.10	0.10	0.22	0.04
Figs	2.92	1.35	0.05	0.23	0.10	0.15	0.00

ount of this dietary factor. This is confirmed by the results obtained in ration 3 which contains neither flaxseed meal nor millet seed. Ration is deficient, not only in the fat-soluble A, but also in salts.

It is difficult, if not impossible, to obtain even moderate growth over an extended period on a diet restricted to the seeds of plants. Since the water-soluble B is abundant in all the seeds, and the fat-soluble A present in large quantities in some of them, the failure of the seeds to promote growth must be attributed to the composition of their inorganic fraction. Of the seven seeds most important for human nutrition and animal production (rice, maize, wheat, oats, beans, cotton, flax) only cottonseed and flaxseed have high inorganic content, and in all of them, as with seeds in general, the seed is very poor in sodium, calcium and chlorine.

The following data are taken from the paper by E. B. FORBES, *Ohio Agricultural Experiment Station Bulletin* 207, 1909.

The leaf and seed rations used to ascertain how far leaves can supplement the deficiencies of the seeds were : —

- 5) rolled oats 50, alfalfa 50 ;
- 6) rolled oats 60, alfalfa 40 ;
- 7) rolled oats 70, alfalfa 30 ;
- 8) wheat 60, alfalfa 40 ;
- 9) wheat 70, alfalfa 30 ;
- 10) maize 60, alfalfa 40 ;
- 11) maize 70, alfalfa 30 ;
- 12) maize 80, alfalfa 20 ;
- 13) maize 90, alfalfa 10 ;
- 14) peas 60, alfalfa 40.

The results obtained led to the following conclusions : —

The leaf is distinctly different from the seed in its dietary properties in several respects: — its total inorganic content is very high, and it is especially rich in both sodium and calcium, both of which are deficient in the seeds generally. In addition the leaf is several times richer in fat-soluble A than are wheat, oat and maize kernels. Certain seeds contain this substance to only the same extent as the leaf; hemp seed is distinctly superior in this respect to the seeds just mentioned, and flaxseed and millet seed are still better than hemp seed. The fat-soluble A content is highest in the smallest seeds, probably because of the relatively large proportion of germ contained in them.

Indian Cattle Census. — *The Agricultural Journal of India*, Vol. XII, Part. IV, p. 676, Pusa, October, 1917.

The following figures, recently published by the Director of Statistics for India are based on cattle censuses which are taken annually in some provinces and quinquennially in others. It is stated that a general census of all provinces will be taken during the year 1919-1920.

The total number of cattle in British India is 147 336 000. Of this, 10 025 079, and bullocks account for 48 664 710, cows for 37 481 273, buffaloes for 19 025 079, and young stock for 42 184 790. The following are the principal figures : —

United Provinces	31 741 000	22 % of total	Burma	5 882 000	} 0 % of total
Bengal	25 324 000	17 %	Assam	3 576 000	
Madras	21 761 000	15 %	North West Frontier Province	1 271 000	
Bihar and Orissa	20 119 000	14 %	Ajmer-Merwara	351 000	
Punjab	15 480 000	11 %	Delhi	148 000	
Central Provinces and Berar	11 857 000	8 %	Coorg	131 000	
Bombay and Sind	9 677 000	7 %	Manipur	6 000	

The number of cattle per 100 acres of cropped area ranges between 32 in Bombay and Sind and 100 in Bengal, while the number per 100 of population ranges between 36 in Delhi and 95 in the Manipur Pargana. The average for British India as a whole is 65 per 100 acres of cropped area and 61 per 100 of population.

The number of sheep is given at 23 015 836, of which Madras possesses 10 765 543 and the Punjab 4 676 899. The number of goats was 3 338 487 horses and ponies, 1 653 379, and mules and donkeys, 1 512 205.

The statistics relating to sheep, goats, horses, and ponies, and mules and donkeys, exclude Bengal, from which no returns regarding these animals are at present received.

318 - **Herd Books of the Argentine Rural Society** (1). — DE ANCHORENA J., in the *Anales de la Sociedad Rural Argentina*, Year I, II, Vol. I, I, pp. 642-644. Buenos Ayres, October 1917.

The appended tables give a summary of the entries in the herd books of the Argentine Rural Society for the last year (October 1, 1916-September 1917) and since their foundation. All pure breeds of cattle, horses, asses, sheep and pigs, whether produced in or imported into the Argentine are included.

A. Argentine Herd Book.

Breeds.	Entries from October 1, 1916 to September 30, 1917				Entries since foundation.			
	Imported animals		Animals born in the country		Total	Imported and home-bred animals		Total
	Males	Females	Males	Females		Males	Females	
Shorthorn	638	79	4 671	4 512	9 930	50 640	53 123	103 763
Hereford	16	—	725	800	1 541	9 354	11 544	20 944
Aberdeen Angus	42	23	492	438	1 015	4 543	4 806	9 349
Red Shorthorn	1	—	6	5	12	145	201	36
Red Polled	—	—	12	13	25	111	125	23
Devon	—	—	5	3	8	20	23	4
Jersey	—	—	9	8	17	44	51	9
Flemish	—	—	33	22	55	167	487	65
Totals	697	102	5 953	5 851	17 603	22 024	70 410	135 418

(1) See *R.*, February, 1916, No. 202. (Ed.)

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B. Argentine Stud Book.

Breeds	Entries from October 1, 1916 to September 30, 1917			Entries since foundation		
	Males	Females	Total	Males	Females	Total
Archeron	285	383	668	2 605	5 878	8 483
Edesdale	129	199	328	1 975	4 890	6 865
Fre	118	165	283	1 721	3 364	5 085
Jackney	123	120	243	1 923	2 804	4 727
Washire	25	27	52	287	731	1 018
Anglo-Norman	10	21	31	192	671	863
Folk-Punch	9	4	13	190	523	713
Polonnais	8	4	12	152	197	349
Unter	9	22	31	62	173	235
Drill	—	—	—	87	110	197
Sho-Pony	6	7	13	60	86	152
Elgian	—	3	3	21	73	94
Setland-Pony	—	—	—	10	24	34
American-trotting	2	—	2	7	23	30
Wienburg	—	1	1	10	16	26
Wolstein	—	2	2	10	13	23
Totals	124	958	1 682	9 318	19 516	28 834

C. Argentine Ass Book.

Breeds	Entries from October 1, 1916 to September 30, 1917		
	Males	Females	Total
Ass	26	92	118
Mule	23	69	92
Total	49	161	210

D. — *Argentine Flock Book.*

Breeds	Entries from October 1, 1916 to September 30, 1917					Total breeding animals entered in the final register and preliminary to the same period.			
	Imported animals		Homebred animals		Prelimi- nary re- gister.	Final		Preli- minary	Total
	Males	Females	Males	Females	Females	Males	Females	Females	
Lincoln	702	50	1 495	1 691	1 016	2 927	8 858	9 745	21 531
Argentine Merino	4	9	486	423	—	1 317	8 155	—	4 472
Shropshire Down	24	—	13	13	18	71	342	152	365
Hampshire Down	5	—	66	87	29	124	367	211	722
Oxford Down	18	3	85	89	36	84	326	1 033	1 441
Romney Marsh	44	—	193	253	86	175	847	391	1 416
Border Leicester	—	—	34	52	—	30	180	—	210
Dixley	—	—	3	3	—	3	3	—	6
Corriedale	—	—	—	—	—	1	—	5	51
<i>Total</i>	<i>195</i>	<i>59</i>	<i>2 375</i>	<i>2 624</i>	<i>2 455</i>	<i>4 711</i>	<i>14 078</i>	<i>11 585</i>	<i>30 464</i>

R. — *Argentine Swine Book.*

Breeds	Entries from October 1, 1916 to September 30, 1917			Entries since foundation		
	Males	Females	Total	Males	Females	Total
Berkshire	679	961	1 640	4 895	6 247	11 142
Midde White York- shire	183	134	257	1 511	2 023	3 534
Tamworth	88	159	244	170	301	471
Large Black	102	122	230	1 271	1 400	2 671
Duroc-Jersey	22	33	52	58	71	129
Poland-China	—	—	—	111	134	245
Large White	—	—	—	43	67	101
Hampshire	—	—	—	4	6	10
<i>Total</i>	<i>1 017</i>	<i>1 408</i>	<i>2 423</i>	<i>8 066</i>	<i>10 259</i>	<i>18 325</i>

319 — The Stud Beef Cattle Breeders' Association of Australia. — *The Pastoral Review*, Vol. XXVII, No. 10, p. 933. Melbourne, October 16, 1917.

The movement initiated in Sydney about three months ago in the direction of forming a stud beef cattle breeders' association received official endorsement when the members of the *Stud Beef Cattle Breeders' Association of Australia* met in general meeting to consider and adopt the rules and regulations drawn up by the provisional council.

The future value of the organisation in fostering pure cattle breeding was generally recognized, as well as the fact that the opportunities of doing

valuable work in this direction in Australia are boundless. The men who have been elected to manage this new Association are well-known and successful breeders from the various States of the Commonwealth and are fully competent to make it an unqualified success.

320 — **On the Use of Certain Marine Algae for Feeding Horses.** — ADRIAN, in *Comptes rendus des Séances de l'Académie des Sciences*, Vol. CI, XVI, No. 1, pp. 54-56. Paris, January 7, 1918.

The author, having been offered a product obtained from Laminarias to be used for waterproofing cloths, noticed that the composition of the treated seaweed resembled that of oats, as is shown by the appended figures: —

	Laminarias treated	Oats
Water	14.40 %	12.55 %
Carbohydrates	52.90	66.80
Nitrogenous matter	17.30	9.10
Cellulose	11.50	8.45
Ash	3.90	3.10

The author tried the product on 2 lots of 3 horses suffering from lymphangitis; one lot, used as control, was given the ordinary feed of oats, hay, straw, while for the second the seaweed replaced the oats.

After 24 days, it was found that the horses fed on seaweed had increased in weight by 6 %, while their general condition was much improved, and the lymphangitis had disappeared, though still persisting in the first lot. This action on the disease, if it is confirmed, might possibly be due (according to MM. LAPICQUE and LEGENDRE of the Museum, who were consulted on this question) to the traces of organic iodine in the algae.

One certain result was obtained: — horses had eaten, digested and assimilated the new food replacing oats.

A further experiment was tried with 2 lots of 20 cavalry horses; the first lot were fed normally, while the second received 1 kg. of alimentary seaweed replacing 1 kg. of oats.

The experiment, which lasted 2 months, confirmed the previous one; the horses fed on the seaweed had put on 13 kg. by the end of the trial, while the control horses had barely gained 2 kg.

The author considers 0.750 kg. of alimentary seaweed to be equivalent to 1 kg. of oats.

The experiment is all the more interesting since Laminarias are abundant on the coast of Brittany. The author discusses their use in human nutrition, as regards which very interesting results have been obtained.

321 — **Relation between the Weight of the Carcass and that of the Meat in Beef Cattle.** — DECHAMBRE, in *Comptes rendus des Séances de l'Académie d'Agriculture de France*, Vol. IV, No. 1, pp. 25-28. Paris, January 9, 1918.

The meat obtained from an animal is equal to the difference between the net weight and the total weight of the bones, suet, etc. The most

important of these factors is the carcass, a knowledge of which would form a sound basis for the selection of slaughter breeds.

The relation between the weight of the carcass and that of the meat is influenced by many factors, such as age, sex, breed, maturity, and, above all, the condition of the animal produced by the degree of fattening. The author's experiments to determine this relation were carried out with a large number of animals, representing a total weight of meat of 51 031 lbs. in quarters containing 9 788 lbs. of bone. The average ratio of bone to meat is, therefore, 19.18 %. The extent of fattening greatly influences this ratio. It is usually expressed by the yield per cent. in meat, which is the ratio between live weight and the weight of the quarters. In the meat studied the extent of fattening is dependent on the amount of suet removed for preserving. The author, therefore, determined this amount and calculated its ratio to the weight of the quarters. When this ratio is compared with that between the bone and meat, it is seen that the figures vary inversely: — the fatter the animal the lower the proportion of bone.

The author's conclusions are: — 1) in medium fat and fat cattle, which generally give a net yield of meat varying between 55 and 58 %, the ratio between bone and meat is between 16 and 18 %; 2) in animals in good condition, yielding 50 to 52 %, the ratio is, on an average, 20 %; 3) in animals yielding less than 50 % (47 to 49 %), the ratio rises to 22 %, or a little more (22.63 %), though still below the 25 % generally admitted in the meat trade.

322 — **A Statistical Study of Body Weights; Gains and Measurements of Steers During the Fattening Period.** — SEVERSON, B. O. and GERLANG, P., in the *Journal of Agricultural Research*, Vol. XI, No. 8, pp. 383-391 + Plates 38-39. Washington, D. C., Nov. 1917.

During the winter months of 1914-1915, 1915-1916 and 1916-1917, a series of body measurements of steers were made at the Pennsylvania Experiment Station, at the beginning and close of feeding experiments, for three consecutive years, with the purpose of determining the average body measurements of 2-year-old steers at the beginning and close of the fattening period and the relationship of other definite body measurements to each other, and to note those measurements that could be used in selection as a means of reducing the experimental error in feeding experiments and a study of variation in the measurements themselves. Another object was to find out the correlation of gains to initial body measurements and to changes in body dimensions.

All measurements taken on a total of 216 animals divided into seven lots each year are indicated in Table I. These steers were relatively uniform as feeders, varying in market grades from "fair" to "choice", the majority being "good" feeders; 92 were Hereford grades, 84 Shorthorn grades, 18 Aberdeen Angus grades, 7 Shorthorn × Hereford crosses, 3 Shorthorn × Aberdeen-Angus crosses, and 3 Hereford × Aberdeen Angus crosses. In no case did a steer fail to show some infusion of improved beef blood. The average initial weight of the 216 steers was 900.112 pounds with 700 and 1300 pounds as extremes. The steers

were as uniform in quality, weight, and condition as would ordinarily be obtained for feeding purposes. Each year 60 steers were divided into five lots of 12 each selected with as much care for uniformity of weight, breeding, condition and quality as possible. The feeding of these various lots was done with rations affording very nearly the same opportunity for gains in live weight and condition of flesh for marketing.

Table I includes all records for the three years, while the correlation tables include the data during the first two years. All body measurements except circumferences were made with the steel caliper; all circumferences were measured with a steel tape graduated in inches. The probability of error in measurements is a factor not considered, thus necessitating a larger number of measurements to reduce the probable error.

TABLE I. — *Average initial and final measurements of 2-year-old steers fattened for market during a 140-day feeding period.*

Measurement	Initial measurement.		Final measurement.		Difference in measurements	Percentage increase
	Number of steers	Average	Number of steers	Average		
		Pounds		Pounds	Pounds	
Weight	216	900.112	216	1,188.398	288.286	32.02
		Inches		Inches	Inches	
Width of head	214	8.832	216	9.112	0.280	3.16
Length of head	214	19.411	216	19.892	0.481	2.48
Length of neck	103	19.163	72	20.090	1.827	9.53
Width of shoulders	214	16.412	215	18.459	2.047	12.42
Width of front flank	214	16.378	216	18.356	1.978	12.08
Width of paunch	214	23.612	216	26.101	2.489	10.54
Width of rear flank	154	19.527	216	22.744	3.217	16.42
Width of loin	209	13.984	216	15.958	1.974	14.11
Width of hips	202	17.662	216	19.254	1.592	9.01
Width at thurls (Hip joint)	209	17.204	215	18.533	1.329	7.72
Buttock to hip	214	18.366	216	19.622	1.256	6.83
Depth of chest	154	20.730	215	27.789	7.059	33.96
Shoulder point to ground	211	33.033	216	34.311	1.278	3.86
Chest to ground	211	22.876	216	24.013	1.137	4.93
Hind flank to ground	214	29.128	216	30.202	1.074	3.68
Hock to ground	142	20.795	204	20.914	0.119	0.57
Cutlers to ground	214	49.224	216	53.870	4.646	9.43
Tip to ground	202	50.855	214	52.411	1.556	3.05
Shoulder to buttock	214	53.763	216	57.088	3.325	6.18
Circumference of chest	214	73.014	216	77.694	4.680	6.40
Circumference of paunch	214	80.256	216	88.301	8.045	10.02
Circumference of hind flank	214	71.161	216	78.685	7.524	10.52
Circumference of muzzle	141	17.198	143	17.930	0.732	4.23

These 216 steers gained at the rate of 2.058 pounds daily for 140 days. The following average initial measurements show a marked similarity: the length of head, length of neck, and width of rear flank, which

vary from 19.163 to 19.527 inches; the width of shoulder and front flank differ by only 0.034 inch; the hips and thurls (hip joint) in width are 17.68 inches and 17.204 inches, respectively; and circumference of the body in the region of the chest and hind flank are 73.014 and 71.364 inches respectively. The height at the withers of a "feeder" steer is 1.631 less than the height at the hips. The length of body from shoulder point to buttock is only 2.908 inches greater than the greatest height at the hips.

The average measurements at the conclusion of the fattening period show similarity as follows: The length of head, width of hips, and distance of buttock from hips varying within 0.638 inch of each other; the width of shoulder, front flank, and thurls are almost identical; and the circumference of the chest and hind flank are more alike than their initial measurements.

The height has increased more at the withers than at the hips; thus a 2-year-old steer changes his greatest height from the hips to the withers while receiving market conditions. In circumference the increase was greater for the hind flank than for the chest; thus the greater circumference of the chest at the initial measurement becomes less than the circumference of the hind flank in the finished steer. In fattening, the greatest width at paunch and the greatest depth of body at the chest become more nearly alike, as shown by a difference of 3.118 inches at the initial measurement and 1.688 inches at the concluding measurement.

In all cases the difference between the initial measurement and the final measurement shows an increase in dimensions due to depositions of fat, muscular development and growth. The regions of the body covered by the greatest amount of muscular development show greater increase in dimensions than those having less muscular covering.

In the regions where the growth would show the greater relative influence the least changes take place as shown in the width of head, length of head, distance from chest to ground and hock to ground. The greatest increase in width took place in the hind flank rather than in the paunch where it would seem natural to have the greatest increase because of feed capacity and condition. The thick layer of flesh and fat deposits in the region of the hind flank, together with the distension of this region of the body in a fattened steer, are responsible for the greater width in this part of the body. The width of loin, hips, thurls, shoulders, and front flank show changes in dimensions caused mainly by increased condition of flesh.

The increase in height at the withers of 4.646 inches is not all due to growth alone, a larger portion of this increase being caused by the flesh covering over the withers and the deposition of fat in the muscular tissue of the shoulder region. The fat deposit and muscular development cause the shoulder blade to be held more rigidly; thus, the body in the chest region rises between the shoulder blades, as indicated by the greater distance between the withers and the upper border of the shoulder blade. The greatest change in the body measurements was the circumference of the paunch. This, however, was proportionately less than the increase of 7.321 inches in circumference of the hind flank. The fact that the distance of chest to

ground and hind flank to ground did not show greater difference was due to lowering of the flank by deposition of fat in that region and the fat covering over the region of the chest. The region of the body possessing the most valuable eatable parts on the whole are affected most in the fattening process.

CORRELATION TABLES. The following table is here presented as illustration of the methods used in obtaining the facts presented in tables III and IV.

TABLE II. — *Correlation of average daily gain of steers during a feeding period of 120 to 140 days and the weight at the beginning of a feeding period.*

Daily gain (pounds)	Initial weight per steer (pounds)														Total
	1 300	1 250	1 200	1 150	1 100	1 050	1 000	950	900	850	800	750	700		
3.2	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1
3.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
2.8	—	—	—	—	1	1	3	1	1	2	1	1	—	—	11
2.6	—	—	—	—	—	4	2	2	4	1	3	3	1	—	20
2.4	—	1	—	1	2	1	5	8	11	7	6	3	2	—	47
2.2	—	1	—	2	2	—	4	7	4	7	4	5	—	—	36
2.0	1	1	—	3	—	1	4	7	9	16	9	12	2	—	65
1.8	—	1	—	3	2	2	5	7	11	10	9	7	6	—	63
1.6	—	—	1	—	—	1	5	3	5	4	4	5	4	—	32
1.4	—	—	—	1	2	—	4	4	10	3	7	1	1	—	33
1.2	—	—	2	—	—	2	2	4	2	6	2	1	1	—	22
1.0	—	—	—	—	—	—	—	1	2	—	1	1	—	—	5
0.8	—	—	—	—	—	1	—	—	2	—	—	—	—	—	3
Total	1	4	2	10	9	13	34	45	61	56	46	33	17	338	
Mean live weight	pounds 893.93 ± 3.94														
Mean daily gain	do. 1.95 ± .016														
Standard deviation of live weight	do. 106.88 ± 2.777														
Standard deviation of daily gain	do. 0.446 ± .011														
Correlation	do. 0.0364 ± .036														

The results shown in table III are based on data collected on steers during the two winter periods of 1914-15 and 1915-16. All measurements considered in this table are initial measurements, except those that show increases of dimensions at the close of the fattening period as compared with the initial measurements. The coefficient of variation is shown to be greatest on increases in circumference of hind flank, paunch, and chest, and the increase in gains in live weight.

These measurements all relate to increased dimensions and occur in those parts of the body that show relatively high percentage increase over initial body measurements (Table I).

Of the initial measurements the greatest coefficient of variation is 11.9 ± 0.04 per cent for initial live weight. In all the chest measurements the coefficients of variation are relatively high: Width at point of shoulder

9.3 \pm 0.52, width of fore flank 10.4 \pm 0.6, depth of chest 6.1 \pm 0.34, and circumference of chest 6.9 \pm 0.39. Likewise the mid and posterior regions of the body show variations, the rear flank with a coefficient of variation of 8.7 \pm 0.48, circumference of rear flank 6 \pm 0.34, width of loin 7.5 \pm 0.43, width of thurls 5.9 \pm 0.34, circumference of paunch 11 \pm 0.62 and distance of hips to buttock 5.2 \pm 0.29.

The measurements affected most by growth show the least variations and include the distance of shoulder point, rear flank, and withers from the ground, length of head, and distance of shoulder point to buttock.

In general Table III shows the greatest variation in those regions of the body which change most in a fattening steer and those regions affected most by deposition of fat and development of muscular tissue.

TABLE III. — Means, standard deviations, and coefficients of variation presented in correlation tables.

Number of steers	Measurements	Mean	Standard deviations	Coefficient of variation
		pounds	pounds	Per cent
388	Average daily gain . . .	1.93 \pm 0.016	0.446 \pm 0.011	23.1 \pm 0.84
388	Initial live weight . . .	893.93 \pm 3.94	106.88 \pm 2.77	11.9 \pm .04
142	Total gain in live weight	288.55 \pm 3.10	54.77 \pm 2.19	19.1 \pm 1.08
		Inches	Inches	
142	Increase in circumference of chest	8.13 \pm .10	1.87 \pm .074	23.0 \pm 1.30
142	Width of rear flank . . .	19.25 \pm .09	1.69 \pm .06	8.7 \pm .48
142	Circumference of rear flank	72.76 \pm .25	4.40 \pm .17	6.0 \pm .34
142	Height of shoulder point	34.10 \pm .08	1.57 \pm .06	4.5 \pm .25
142	Height of rear flank . .	30.23 \pm .09	1.67 \pm .06	5.5 \pm .31
142	Distance, hip to buttock	18.69 \pm .05	.99 \pm .03	5.2 \pm .29
142	Width of loin	13.96 \pm .06	1.05 \pm .22	7.5 \pm .43
137	Circumference of chest .	69.82 \pm .22	3.91 \pm .01	6.9 \pm .39
142	Depth of chest	25.77 \pm .08	1.59 \pm .063	6.1 \pm .34
142	Width of fore flank . . .	15.02 \pm .08	1.57 \pm .06	10.4 \pm .60
142	Distance, chest to ground	22.89 \pm .06	1.18 \pm .04	5.1 \pm .28
136	Width of thurl	17.36 \pm .05	1.03 \pm .04	5.9 \pm .34
142	Length of head	19.53 \pm .04	.81 \pm .03	4.1 \pm .23
142	Length of shoulder to buttock	55.66 \pm .17	3.02 \pm 2.84	5.4 \pm .30
142	Increase in circumference of paunch	8.26 \pm .16	2.06 \pm .11	35.8 \pm 2.02
142	Height of withers	49.50 \pm 1.07	1.95 \pm .07	4.9 \pm .27
142	Width at point of shoulder	16.42 \pm .08	1.54 \pm .06	9.3 \pm .52
142	Circumference of paunch.	81.60 \pm .56	10.04 \pm 4.02	10.0 \pm .62
138	Increase in circumference of rear flank	7.52 \pm .20	3.51 \pm .14	46.6 \pm 2.67

Table IV, a summary of the coefficients of correlation, shows that increases in body measurements have a closer relationship with gains in live weight than the initial measurements. With the exception of initial weight

these measurements, as shown in Table II, also had high coefficients of variation.

The correlation coefficients for the two body circumferences of chest and rear flank, the width of thurls (hip joint), and the distance of hip to buttock show the closest relationship of all the initial measurements with gains in live weight. This suggests the possibilities of using these measurements in the selection of feeding steers, at least for experimental purposes, as a means of reducing the experimental error caused by individuality of animals.

The measurement of initial weight shows no relationship with gains, although this is usually considered one of the most important factors in selection of steers for experimental purposes.

Measurements that show intermediate relationship as indicated by coefficients of correlation are width of loin, depth of chest, width of fore flank, length of head, height of withers, circumference of paunch and width at shoulders.

TABLE IV. — Summary of correlations.

Correlating	Correlation coefficient	Correlating	Correlation coefficient
Gain with initial live weight	0.036 ± 0.036	Gain with initial length of head	0.182 ± 0.037
Gain with increase in circumference of chest	$.160 \pm .044$	Gain with initial length from point of shoulder to buttock	$.020 \pm .056$
Gain with initial width of rear flank	$.079 \pm .083$	Gain with increase in circumference of paunch	$.306 \pm .036$
Gain with initial circumference of rear flank	$.221 \pm .053$	Gain with initial height of withers	$.103 \pm .054$
Gain with initial height of point of shoulder	$.061 \pm .056$	Gain with initial width of shoulders	$.144 \pm .055$
Gain with initial height of rear flank	$.053 \pm .055$	Gain with initial circumference of paunch	$.124 \pm .055$
Gain with initial length of hip to buttock	$.271 \pm .053$	Gain with increase in circumference of rear flank	$.203 \pm .055$
Gain with initial width of loin	$.108 \pm .085$	Width of thurls with height of rear flank	$.380 \pm .049$
Gain with initial circumference of chest	$.238 \pm .053$	Circumference of chest with height of withers	$.621 \pm .034$
Gain with initial depth of chest	$.130 \pm .046$	Width of loin with height of chest from ground	$.179 \pm .057$
Gain with initial width of fore flank	$.164 \pm .051$	Width of chest with depth of chest	$.365 \pm .072$
Gain with initial distance of chest to ground	$.077 \pm .056$		
Gain with initial width of thurls	$.224 \pm .054$		

Measurements in which slight or no relationship exist as shown by correlation coefficients are initial live weight, width of rear flank, height at shoulder point and the distance of rear flank and chest from the ground.

A close relationship of circumference of chest with height of withers

is indicated by $r = 0.621 \pm 0.034$. Likewise, the width of chest and depth of chest by $r = 0.365 \pm 0.072$ show a definite relationship.

The hind quarters of a steer are more important than the fore quarters in determining the gaining capacity of a steer, with the exception of the circumference of chest as shown by a correlation coefficient of 0.224 ± 0.054 for width of thurls, 0.271 ± 0.053 for distance of hip to buttock and 0.221 ± 0.053 for circumference of rear flank.

The following points (see p. 361), held by authoritative judges of live stock to be important, are not substantiated by the results of this study thus far: Initial weight of steers, closeness to the ground of chest and hind flank, and the length of body from shoulder to buttock. The circumference of chest and rear flank are more important in ascertaining gains than feed capacity as indicated by the circumference of paunch.

323 - Influence of the Degree of Fatness of Cattle upon their Utilization of Feed. — ARMSBY, H. PRENTISS and FRIES J. AUGUST, in the *Journal of Agricultural Research*, Vol. XI, No. 10, pp. 451-472, Tables, 1 fig., bibliography of 8 publications. Washington, December 3, 1917.

It is well known that the gain in live weight per unit of feed diminishes as fattening progresses; it is supposed that the cells of the adipose tissues, as they become loaded with fat offer an increasing resistance to the deposition of added fat, to overcome which increased expenditure of energy is required. Consequently a given amount of food gives a smaller gain in fat in a fat animal than in a thin one as a result of a corresponding increase in heat production and a reduction in the net energy value of the feed. Mr. ARMSBY, Director of the Institute of Animal Nutrition of the Pennsylvania State College, and the Assistant Director, Mr. FRIES, have investigated this subject by a direct comparison of the metabolism of an animal in ordinary condition and when well fattened.

Rations and periods.

Period	Preliminary period	Digestion period	Daily ration	
			Hay	Concentrates
			kg	kg
Period 1	November 2-12	November 13-22	1.7	3.4
Transition	(December 23-29)	—	—	—
Period 2	November 30-December 10	December 11-20	3.5	7.0
Fattening	(December 22-March 14)	—	—	—
Period 3	March 15-25	March 12-April 4	3.8	7.6
Period 4	April 5-15	April 16-25	2.0	4.0

METHOD. — *Subject*: a pure-bred shorthorn steer about 2 years and 9 months old at the beginning of the experiment. — *Rations and periods*: the animal received a basal ration of alfalfa hay and a mixture of concentrates (1 part of cottonseed meal, 2 parts of wheat bran and 6 of maize meal). This ration was always fed in the same proportions — 2 parts of concentrates to 1 part of alfalfa hay — and supplied throughout the experiment, which

was divided into four parts (see the appended table). During two successive periods the animal received quantities of this feed equivalent to a maintenance ration (period 1), and to a fattening ration (period 2). Fattening was then started, during which the steer gained 300 lbs. The experiment was continued in the reverse order, a fattening ration being first given (period 3), then a maintenance ration (period 4).

RESULTS. — These two successive comparisons of metabolism resulted in much data (grouped in a series of tables in the appendix) which lead to the following conclusions: —

1) *The digestibility of the heavy ration is smaller than that of the light ration*; it does not depend on the degree of fattening as corresponding rations were equally well digested before and after fattening.

2) *Urinary excretion.* — The percentage of nitrogen, carbon and energy lost in the urine was less on the heavy than on the light ration, and a little greater in the fattened than in the unfattened animal.

3) *The production of combustible gases*, both as compared with the total feed and with the digestible carbohydrates was notably less on the heavier than on the lighter ration, both before and after fattening.

4) *Value of the gross energy of the feed.* — In consequence of the smaller losses in urine and in combustible gases this loss was greater on the heavy than on the light ration; no difference in this respect was observed between a fattened and the unfattened animal.

5) *The additional heat produced by the animal on the heavier rations* as eliminated by means of evaporation of water.

6) *Energy expenditure consequent on feed consumption.* — The heat increment resulting from the consumption of a unit of feed was only a little greater in the fattened condition; consequently the *net* energy values of the feed and the percentages of metabolizable energy available for gain were slightly less in the fattened than in the unfattened animal.

7) The maintenance requirement was increased by 37 % after 3 months' fattening during which the live weight was increased by 300 lbs. This 36 % increase in basal katabolism was partly due to the greater body weight to be supported while standing, but the katabolism increases more rapidly than the weight or the body surface.

8) *General conclusion.* — The higher maintenance requirement and lower fixed metabolizable energy in the fattened animal are the principal factors responsible for slower gain in weight as fattening progresses.

14 - *Breeders of Purebred Stock in Queensland — Beef and Dairy Cattle.* — *Queensland Agricultural Journal*, Vol. VIII, pp. 247-248. Brisbane, November, 1917.

The Department of Agriculture and Stock of Queensland has published in this issue of the *Agricultural Journal* a revised list of breeders of purebred cattle, for the purpose of informing those who desire to improve their stock where the best cattle can be obtained in the State.

The Department of Agriculture and Stock takes no responsibility in relation to the entries in the list; but, when inquiries were first made, the condition was imposed that the entries were to be only of stock that had

been duly registered or that were eligible for registration in the different herd books. As the entries received were, in some cases, somewhat too confusing for proper discrimination, it has, therefore, now been decided that only such cattle as have been registered will be included. This list of breeders of pure bred stock in Queensland shows that all the principal breeds of cattle are represented and that they were registered in 15 different Herd Books, i. e., Milking Shorthorn Herd Book of Queensland; Ayrshire Herd Book of Queensland; Ayrshire Herd Book of Scotland; Holstein Cattle Club Herd Book; Holstein-Friesian Herd Book of Australia; Holstein Friesian Herd Book of Queensland; Jersey Herd Book of Queensland, Herd Book of the Jersey Cattle Society of Queensland; Commonwealth Standard Jersey Herd Book; Illawarra Dairy Cattle Herd Book of Queensland; Illawarra Herd Book of Queensland; Illawarra Dairy Cattle Association; Queensland Shorthorn and Australian Herd Books; Queensland Shorthorn Herd Book; Australian Hereford Herd Book; New Zealand Herd Book.

The total number of purebred males and females owned by these breeders may be discriminated as follows between the different breeds.

	Males	Females
Milking Shorthorns	5	61
Ayrshire	74	371
Holstein-Friesian	22	77
Jersey	35	224
Illawarra	5	48
Shorthorn	27	137
Hereford	114	563

325 — Machine Sheep-Shearing in New Zealand. — See No. 340 of this Review.

326 — Feeding Pigs on Kitchen Waste. — PRIME, T. F., in *The Journal of the Board of Agriculture*, Year XXIV, No. 10, pp. 1107-1109, London, January, 1918.

Finding no data on the amount of kitchen waste necessary to produce one pound of pork, the author carried out experiments on this subject. To this end he started in January 1917 to keep pigs on this food and continued during 48 weeks. Three pigs were bought on January 9, two of which were killed on March 5; four others were bought on March 10, one being killed on June 7; on September 1, five more pigs were bought. Throughout the experiment 6104 lbs. of food were consumed, and 870 lbs. increase in live weight were obtained, or roughly, 7 lbs. of kitchen waste (potato vegetable and fruit peelings and waste, bits and remains of food) produced 1 lb. increase in live weight. During the whole period the only other food used was 28 lbs. of meal, given during a shortage of waste. The pork obtained was of excellent quality.

327 — New Silkworm Rearing Methods; the Acqua Small Trestle System and the Campbell Shelf System. — ACQUA, C., Rearing early stage silkworms by means of small trestle with immersed twigs, *Rendiconti dell'Istituto biologico della R. Scuola Superiore di Agricoltura in Portici*, Vol. II, pp. 3-12, figs. 2; CAMPBELL, C., Some new methods for rearing silkworms, *Ibid.*, p. 23-29, figs. 2. Portici, 1917.

For some years, attempts have been made to diffuse the economic method of rearing employed in Friuli throughout Italy. This system consist

in giving the larvae, after the 3rd. or 4th. stage, leaves attached to the boughs, using horizontal hurdles or special trestles as supports. For the first stages, the Friulian system does not differ from these ordinarily used. The author has a system, by means of which the larvae can be reared on boughs from hatching. To preserve the leaves fresh and tender, and to avoid loss due to the rapid withering of the cut leaf, the lower ends of the branches are kept immersed in a small basin of water, placed on a shelf attached to the lower part of each side of a small trestle, some 20 in. \times 20 in. square, (fig. 1). A metal sheet is spread over the trestle, and covered with cardboard, strong paper, or even gauze. The small basin is provided with a stoppered opening, so that the water can be changed without moving the recipient. When the leaves are eaten, fresh boughs are placed with their ends in the water (which has been changed), care being taken to place them close to the old boughs; the young silkworms soon pass on to the fresh

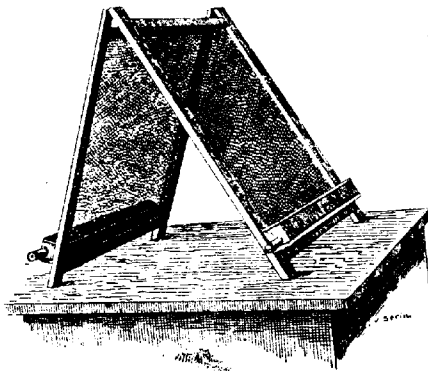


Fig. 1. — ACQUA trestle method.

leaves; the day after, the old boughs are removed. Four small trestles suffice for rearing 2 ounces (60 gm.) of eggs up to the end of the second stage; the system may be used for the third stage, by employing larger trestles. Thus, for 2 ounces (60 gm.) of eggs, a trestle, 6 ft. 6 in. \times 6 ft. 6 in., would be used, divided in two by a small shelf on which a small basin is placed, as with the lower one. For the 5th. stage, it is useless to place the boughs in water, as the larvae eat the leaves before they have time to wither and losses due to withering are not to be feared. With this system there is economy of labour, a saving of leaves, and better hygiene, due to the suppression of litter.

The small trestle of Prof. ACQUA gave good results in the hands of private rearers, as well as at the Sericultural Institute of Portici.

Prof. CAMPBELL has introduced a slight modification into the system. The trestle devised by him is about 3 ft. long and 1 ft. 6 in. high; on the frame

is stretched a cloth which remains till the end of the season, when it is washed and replaced. At the foot of the trestle is the shelf on which is



Fig. II. — CAMPBELL shelf method.

placed the basin, above which is a board perforated with holes to receive the ends of the mulberry branches ; with this device there is no fear of the larvae falling in the water and drowning, while the water is also protected

rom dust. Prof. CAMPBELL is of the opinion that this system should become widely used, especially in southern Italy, where the high temperature and dry climate soon cause the leaves to wither and lose their freshness.

To restrict the space required so as to approximate that necessitated by the Friulian system, Prof. CAMPBELL has devised a system for rearing stages following the first one, and which consists of hurdles or supports (fig. 2) placed one above the other in pairs, 6ft. 6 in long and 3ft. 3 in. apart; the double series together thus being 6ft. 6 high. On each support are small shelves, each 2ft. wide and inclined inwards; the boughs are placed upright on these shelves, their tops being supported obliquely by transverse ledges.

The mulberry branches are placed successively on the shelves according to the development of the larvae, and the length of the branches available. In the 4th. and 5th. stages the branches can be placed up to the third shelves in measure as the branches are gradually stripped. The branches are first placed in one half of the trestle, and when this is quite full and the larvae have eaten all the leaves, the branches are placed in the opposite half well in contact and interlaced with the branches on which are the larvae, so that they can easily pass on to the fresh boughs.

As an alternative, both sides of the trestle may be used by slightly separating the branches on which are the larvae, and placing the fresh branches in the gaps between, when the first are completely eaten. The old branches are removed when the larvae have left them.

The oblique shelves prevent the larvae from falling to the ground or on the lower shelves, and also receive the excreta. At the end of the 5th. stages, the heath is placed in the upper half of the trestle and the larvae move into it of their own accord.

This system gives economy of space and labour, as well as better hygienic conditions due to the good ventilation.

8 - On Some Cytological Data on the Phenomena of Parthenogenesis in the Silkworm (1). — LECAILLON, A., in *Comptes rendus des Séances de l'Académie des Sciences* Vol. 166, No. 4, pp. 180-181. Paris, Jan. 28, 1918.

The author gives the results of his investigations into certain fundamental points concerning the changes which taken place in the fertilised egg.

1) The examination of consecutive sections of eggs which, towards the third day after being laid, began to turn from yellow to pink, showed that the development of the embryo had already reached the stage where the rum, amnios and embryonic sack were formed, and where the breaking up of the vitellus has already taken place. The stage at which colour begins to change is not a starting stage, but corresponds to an already advanced development. The appearance of the pink colour is due to the deposition of pigmented granules in the cells of the serous envelope against the vitelline membrane. This stage is exactly similar in the fertilised egg.

(1) See *R. April*, 1916, No. 427; *Oct.* 1917, No. 936; *Nov.*, 1917, No. 1050; *Feb.*, 1918, No. 197.

2) In unfertilised eggs which have not changed colour and have been laid a sufficiently short time for the cellular degeneration to be still visible, an intravitelline segmentation was observed similar to that taking place in the fertilised eggs of most insects, except that more or less premature cessation of development was manifest.

3) In unfertilised eggs which had kept their original yellow colour, but which were from 10 to 12 days old, cellular degeneration was much more marked than in the preceding case.

4) These facts confirm and extend those already given by the author in a preceding note (1), which showed that, in the eggs of *Bombyx mori* which do not change colour, important phenomena of development take place. The capacity for parthenogenesis in the silkworm, therefore, really corresponds to a quality proper to the female reproducing element and not to a property peculiar to eggs which change colour after being laid.

The earliest stages of degeneration observed in *Bombyx mori* which only correspond to a segmentation stopped very early seem in every way comparable to the rudiments of development observed in birds.

FARM ENGINEERING.

329 - **The Work of a Tractor in Stony Soil.** — PLUCHET, E., in *Comptes rendus des Séances de l'Académie d'Agriculture de France*, Vol. III, No. 36, pp. 1037-1040. Paris, November 21, 1917.

The author advised the purchase of a 10-20 HP. tractor for a large estate at Eure-et-Loire, France, having a number of stony areas. The tractor was chosen, on the recommendation of M. RINGELMANN, from amongst those tested at Noisy-le-Grand (2).

Paraffin was used as fuel, being so much cheaper than petrol; heavy oils of at least 39° Baumé could also have been used. The tractor began work on uncultivated ground about July 15, 1917. For various reasons, such as bad weather, harvest work, holidays, etc., the tractor only worked 340 hours, or 45 days of 8 hours, from the above mentioned date up till the end of October. During this time 160.6 acres were worked to a depth of 7 to 8 inches (about 1 acre in 2.2 hours), in very stubborn and stony soil. In these soils, the usual implements and tools wear very quickly and the average work done by 1 man with 3 horses does not exceed 4,200 to 4,800 sq. yds. per day.

The 160.6 acres worked cost about £ 110. 3s. for fuel, lubricants, socks and new parts, repairs and upkeep. The working parts of the machine did not seem to have suffered, in spite of the difficult ground. The tractor was driven by the estate foreman; in spite of this, the author allowed the drivers the pay of 9½d. an hour; on adding, for the working hours £ 13. 12s. to the expenses, the total became £ 123. 15s. and each acre worked cost 15s. 5d.

(1) See R. Oct., 1917, No. 936. — (2) See R., November, 1917, No. 1051 and R. January 1918, No. 81. (Ed.)

The author has only been able to estimate very roughly the depreciation of the machine, etc. Supposing that the tractor, which cost £500, can last three years if well cared for, the depreciation would amount to about £13.18s. a month, giving say £48 13s. for the 3½ months of work. The total cost for the 160.6 acres would then amount to £172. 8s, or, 21s. per acre, which is very high for work at 7 to 8 inches deep, but little higher than the cost for the same work performed by animals.

This example again shows the advantage of machine cultivation and the great help it may afford under the present circumstances, even with imperfect machinery.

330 - Cultivation Trials with a Moline Tractor, in Italy. — TARCHETTI, A., in *Il Giornale di Riscoltura*, Year VII, No. 22, pp. 278-282. Vercelli, November 30, 1917.

Cultivation trials with the combined Moline tractor (I) were carried out in ricefields, in October and November 1917, by the Machinery Section of the Experimental Rice-growing Station at Vercelli.

The first trials took place at Muleggio (Vercelli) in both ricefields and ordinary ones. The tractor drew a 2-furrow 12 in. plough, to which was fixed, according to the ricegrowers' wishes, an ordinary coulter as well as a skim coulter replacing the circular coulter.

The wheels were provided with 3 rows of cuneiform spikes projecting 4 in. beyond the tyre. In the ricefield the average speed when working at 6 to 7 in. was about 3 miles per hour; in the ordinary field the speed was 2½ miles per hour at a depth of 7 to 8 in. and a width of 24 in., which correspond respectively to 3 468 and 2 870 sq. yds. of surface covered per hour. These first trials gave quite satisfactory results.

The next trials were carried out at Castelmerlino (Vercelli) in a well-manured riceland, in good general condition, save one short and difficult strip which was very soft. Instead of spikes, the wheels were fitted with strakes projecting some 5 ins. The author gives the following results obtained one period of the trial: —

Duration of trial: 2 hrs., 4 mins., 20 secs., i.e.	7460 seconds
Divided up as follows: —	
Duration of ploughing (average of 3 minutes per furrow of 618 ft.	3960 "
Duration of turning (average of 30 secs.) by towing	660 "
Total duration of the work	4620 "
Optional stoppages for adjustments of plough, measuring, etc.	2840 "
Total time.	7460 "
Average depth of ploughing	7 to 8 in.
Area ploughed: — average furrow length	618 ft.
Total furrow width	50.15 ft.
Area ploughed during the trial	2994.2 sq. yds.
Petrol consumed during the trial 2.42 galls. equal to 16.94 lbs. (density 700)	

(1) See R. 1917, No. 941, (Ed.)

The conclusions are:

Petrol consumed (1)	per acre	14.3 lb.
	hour.	8.16 lbs.
Area ploughed per hour		2762 sq. yds.

Using these results, the author calculates the cost of mechanical ploughing per day: —

The *MOLINE* tractor with a 2-furrow plough and accessories costs £600 in Italy; assuming that the petrol costs 7d. a lb. and that a tractor is used on 80 days during the year, the daily cost would be:

Petrol for 10 hours work 88 lbs. at 7d. a lb.	51s. 4d.
Driver's wages	8s.
Lubricating oil	3s. 2d.
Interest and depreciation at 5% on £600 and assuming the machine to last 10 years.—say	20s.
Insurance, various expenses	6s. 4d.

Daily cost 83s. 10d.
that is, one acre costs 14s. 9d.

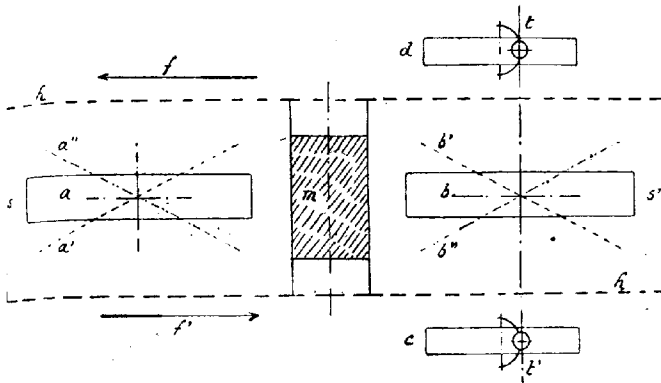
The author observes that machine ploughing is fairly costly but under present conditions, given the scarcity of labour and draught animals, it is important to produce as much as possible.

331 — **The Dessaules Tractor.** — RINGELMANN, MAX, in the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale*, Year CXVI, Vol. CXXVII, No. 6, pp. 476—478, fig. 1, Paris, November-December, 1917.

The **DESSAULES** tractor took part in the 1917 trials at Noisy-Je-Grand (2), France; the test model was made by M. H. DESPLAND, of Levallois-Perret, Seine. The appended schematic figure shows the type of machine, which has 2 driving and steering wheels *a* and *b*, which can turn obliquely in the directions *a'* and *b'* or *a''* and *b''*; these wheels are placed one behind the other, transverse equilibrium being provided for by two pivoting wheels *c* and *d*, mounted on forks, fixed to a beam *u'* attached to the upper part of the frame, whose plan is shown at *h*. The engine *m*, placed low down between the driving wheels, chain-drives an intermediary shaft just above it; the shaft drives, through 2 chains, two axles placed above the wheels *a* and *b*; the driving-wheels are driven by 2 chains-drives from these axles; the gearing thus includes 5 chains, which should not run at the same speed, as in the experimental model. The driver's seat being placed either at *s* or *s'*, the machine can move either in the direction *f* or *f'* in a turnip-field, without turning on the furrow; the hauling attachment is at *h*, on *s* or *s'*.

(1) The petrol consumption on normal work would be 8.8 lb. per hour and 16 lb. per acre.
(Author)

(2) See *R.* January, 1918 No. 81. (Ed.)



Plan of DESSAULES tractor.

332 - **The Wyles Motor Plough.** — I. *The Agricultural News*, Vol. XVI, No. 406, p. 357. Barbadoes, November 17, 1917. — II. PREMIER, VICTOR, in *Le Génie Rural*, Year X, No. 76, (New Series, No. 16), pp. 11-15, figs. 5. Paris, 1917.

According to information received by *The Agricultural News* from the Secretary of the Food Production Department of the Board of Agriculture and Fisheries, England, it would appear that the WYLES motorplough is well suited for work in orchards and on small farms, while being unsuitable for large farms.

This English-made motorplough is guided by handles by a man walking behind; the 2-furrow plough can be lifted so as to clear the headlands, as the weight of the machine is well balanced about the front axle.

All parts of the machine are standardised and can easily be replaced.

The chief points of the WYLES motorplough are as follows:

1 cylinder vertical 11 HP engine.

Gears completely enclosed and working in an oil bath; 2 forward speeds are provided; a reverse is unnecessary.

Wheels — diameter, 2 ft. 9 in.; tyre, 7 in. wide; length, 12 ft. 6 in.; width, 2 ft. 9 in.; height, 4 ft.

Including a 2-furrow plough, it weighs about 20 cwt.

This motorplough, though possibly not very suitable for strong sugar-cane fields, would work very well in light soils, and in cotton fields, etc. It is made by the WYLES MOTOR PLOUGHS Co. Ltd., of Manchester.

II. — The WYLES patent, No. 464 699 (1913), described in *Le Génie Rural*, includes a new device for the steering and general control of wheeled agricultural machinery, such as motorploughs, etc. The cultivating implement may be varied as required. The machine is easily steered and becomes quite automatic (provided that the engine has a regulating device); it requires no attention save in turning at the headlands.

Another WYLES patent, No. 477 074 (1914), concerns improvements of a mechanism regulating the wheels which uses the power of the engine, driving the carrying wheel or wheels, to lift the body of the machine automatically.

Designs are given with the patents, showing details of the inventions.

- 333 - **The Blanchard (1) Double Brabant Windlass Plough.** — RINGELMANN, MAX, in the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale*, Year CXVI, Vol. CXXVIII, No. 6, pp. 473-476, 4 fig. Paris, November-December, 1917.

The BLANCHARD double-brabant plough is of the windlass-plough type; it carries the engine and 2 reeling drums, on each of which is rolled a cable whose end is anchored in the furrow.

An Ardennes farmer, M. BLANCHARD has invented the machine, the model tried at Noisy-le-Grand, France, having been made by M. E. ALLONGÉ of Paris. Figure 1 shows the general view of the machine, while figure 2 shows its plan. In the latter various details can be seen: — the machinery fixed to the support of a double-brabant plough; the beam *a*; the ploughs *b* and *b'*; the furrow wheel *c* running in the furrow *x*, and the land-wheel *c'* running at *x'*; the grounding screw *d* and the stilts *e* that carry the locking mechanism; the stays turning round the beam *a* fixed to the support *ee'*.

The machinery fixed to 2 bars of the wheels *cc'* includes a small 3-4 HP. single-cylinder engine *A*; the cooling of the cylinder ribs is provided for by a lateral fan; the petrol tank is placed on a shelf supported at *f*. The engine shaft is connected by a chain drive *g* to an intermediary shaft *B*; the windlasses *C* are mounted on a shaft driven by a chain *i* from *B*; in these 2 drives, reducing the engine-speed, the tension of the chains are regulated by rollers *h* and *j*. The 2 windlasses *C* can each be geared up to the shaft on which they are mounted when they pull the plough by rolling up the cable *m*, or put out of gear when the cable *n* is unrolled behind on the untouched strip *x'*. In the machine tested by the author, the cables, when used for traction, pass between guide rollers *l*, which will be replaced in the final model by an automatic winder.

In the trials, the greatest traction could not be more than 770 lbs. equal to the breaking point of the cable. When the plough moves in the direction *r*, it hauls on the cable *m* and pays out the return cable *n* behind. When at the end of the cable, the driver puts the windlass out of gear, removes the cable *m* from the guides *l*, tips and turns the plough so as to place it in position to open the new furrow, fixes the hook of the cable *m* on the anchor chain in the furrow; he then passes the cable *n* between the guide *l* of the second windlass, which he puts in gear, when the plough moves in the opposite direction to *r* to the other headland, when the same process is repeated. The driver walks alongside the machine.

The cables are simply laid down, and are not damaged in any way by rubbing. The anchorage for each cable consists of a chain some 16 ft long.

(1) *Sec R. January, 1918, No. 81 (Ed.)*

held down by stakes ; the cable hook engages in one of the links of the chain, and, each time the plough arrives at the headland, the hook is moved along the anchor chain to a width equal to about twice the furrow width.

BLANCHARD *Double brabant windlass plough.*



Fig. I — View of the machine.

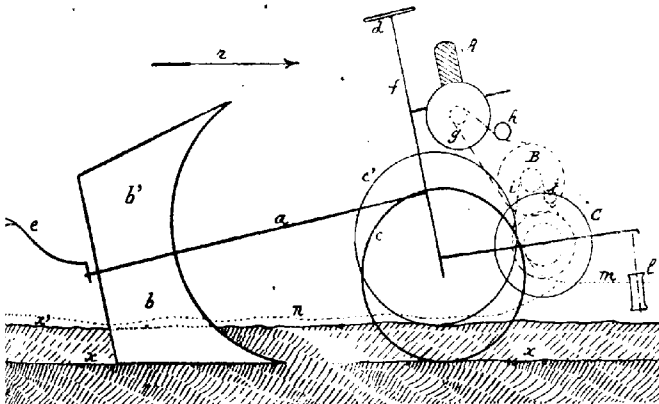


Fig. II. — Diagram of the machine.

334 - **The Shubert Weed and Sprout Destroyer.** — *Farm Implement News*, Vol. XXXVIII, No. 49, pp. 36, 2 figs. Chicago, December 6, 1917.

The extermination of weeds, sprouts, etc., with the usual machines used
The Shubert Weed and Plant Destroyer.

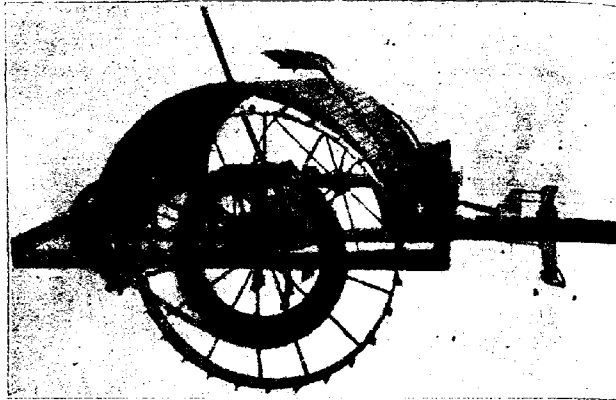


Fig. I. — Side view.

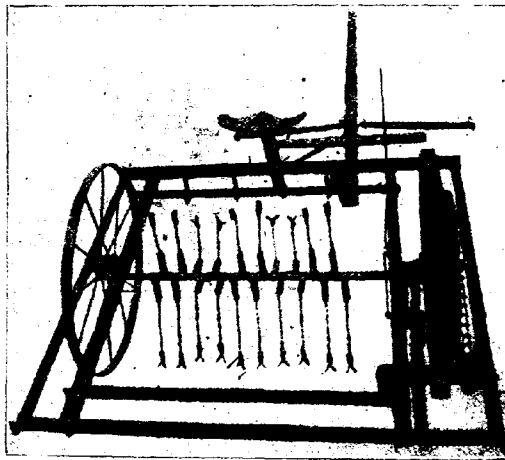


Fig. II. — Rear view.

for that purpose is very difficult and even impossible on stony and stumpy land.

As is shown in the appended figures, the machine is provided with a revolving cross bar to which are attached a number of chains ending in cutting blocks. Power for revolving the chains is derived from one wheel and transmitted by suitable gearing. The chains are whirled at high speed, the velocity being such that any plant struck is reduced to shreds and spread over the ground. Ability to work among stumps and stones is due to the flexibility obtained by using chains, which simply work themselves round obstructions. The cutting ends do not reach the ground, so that grass is left uninjured.

The machine weighs about 850 lbs.; the wheels are about 4 ft. high and the space within the angle iron frame about 4 ft. square. It is made by the SHUBERT SPROUT MOWER COMPANY of Richland Mo., U. S. A.

335 - **Copra Driers.** — See No. 346 of this Review.

336 - **Investigations of Irrigation Pumping Plants, in Montana, U. S. A.** — MURDOCK, H. E., in: I. *University of Montana, Agricultural Experiment Station, Circular No. 6*, pp. 37, fig. 17. Bozeman, Montana, January, 1917; II. *Ibid.*, *Bulletin No. 115*, pp. 127—148, fig. 6, tables 5. Bozeman, Montana, January, 1917.

I. In the United States many irrigation pumping plants have been installed without sufficient forethought and thus have resulted in failure.

In studying the question of installing an irrigation pumping plant, special attention should be paid to well prepared plans, proper types of pumps, cost of plant, maximum head that can be lifted, market conditions and prices of crops to be grown, etc. Crops grown with pumped water should require little water and give high crop value for each acre, while the plant installed should give the maximum running economy with the minimum maintenance charges.

The author considers the various types of pumps; centrifugal pumps, the horizontal type of which is most adapted for lifting not more than 30 ft., while the vertical type is suited for deeper wells of 3 to 6 ft. diameter; turbine pumps, for deep wells (250 ft.) of small bore (12 to 30 in.); plunger pumps, for deep wells of small bore (3 in.). It should be noted that irrigation from deep wells is very dear, and only pays for high-priced crops. Plunger pumps are of very small capacity thus being most suited to filling reservoirs till enough water is stored for a day's irrigation.

Irrigation pumps can be driven by windmills, steam, gasoline and oil engines of the portable, stationary and tractor types. Windmills have long been used for this purpose; if well cared for, they last a long time; they usually drive plunger pumps. Using gasoline for pumping is expensive, and to utilise the cheaper, heavy oils the fuel oil engine has been rapidly perfected. The heavy oil engines have the advantage that with a little adjustment they can use any liquid fuel of a higher grade than that for which they are designed. The operation of a steam engine requires a more skillful mechanic than does an internal combustion machine. The laws of Montana require a licensed engineer to operate a steam engine. There is a

large amount of lignite and soft coal in Montana will could furnish a source of cheap power. Electric motors have many advantages; many plants only require a visit once every 24 hours for oiling and other attention.

Curves are given to help in choosing a pump, use being made of various conditions of speed, head, discharge and power. A few of the most common engine and pump troubles are described as well as methods for remedying them.

As regards the cost of operating pumping plants, the author assumes it as being directly proportional to the lift. For a pumping installation driven by a gasoline motor, the proportional annual cost for the gasoline was 58.7 %, 19.7 % for the irrigator and operator, 15.7 % for interest and depreciation, 5.9 % for lubricating oil; for a plant driven by a paraffin motor the figures were: — 46 % for paraffin, 25.8 % for the irrigator and operator, 20.5 % for interest and depreciation, 7.7 % for lubricating oil; these figures vary very greatly, but can be much reduced by giving as much care to the irrigation as to the pumping plant.

II. The Agricultural Experiment Station of the University of Montana has tested a number of pumps and engines, in order to throw light on the problems of pumping for irrigation. The tests were partly carried out in the University laboratory and partly with plants actually working.

The pumps tested in the laboratory were: CASE plunger pump; FRIEND motor pump; GOULDS Pyramid plunger pump; BYRON JACKSON vertical centrifugal pump; American 7-in. vertical centrifugal pump. The pumps tested in the field were all of the horizontal centrifugal type and were: 1 Morris 18-in.; 1 American 10-in.; 1 GOULDS 8-in., 1 Rumsey 6-in.; and 2 Goulds 6-in. pumps.

The following engines were used in the laboratory tests: — Case 75 HP. steam tractor; International Harvester Company 45 HP. petrol-paraffin tractor; Case 36 HP. steam roller; Fairbanks-Morse 5 HP. vertical petrol engine; International Harvester Company 5 HP. vertical petrol engine; Friend horizontal 4 HP. petrol engine; Int. H. C. I HP. paraffin-engine; Fuller & Johnson 3/4 HP. vertical petrol engine.

The following engines were used in the field: Case 75 HP. stationary steam engine; Fairbanks-Morse 65 HP. stationary steam engine; Fairbanks-Morse 20 HP. horizontal paraffin engine; Galloway 15 HP. horizontal petrol engine; Field 12 HP. horizontal petrol engine; Galloway 8 HP. horizontal petrol engine.

To measure the water discharge, a 2-ft. CIPOLLETTI weir was used. For the field tests a temporary rectangular weir was used when practicable for smaller currents a current meter was used. In tests for power consumption a PRONY brake was used.

The results of the tests are shown in 5 tables which give: the HP. of the engines, the head of water, discharge, the various types of pump tested the water lift, consumption of fuel, and the quantity of lubricating oil used.

The results of the laboratory tests bring out forcibly the inadvisability of using any chance combination of power and pump that may be available. They also indicate what kind of combination should be made to secure an efficient plant. Thus if a 45HP tractor is used to drive a 7-in. vertical pump, with a 50-ft lift, the tests show a fuel consumption of about 0.4 gallon per foot acre-foot, which is very satisfactory. The same tractor driving a 5-in. vertical pump consumes 50 % more fuel; with a 3-in. pump there is

fuel consumption of about 2.5 times the amount required for the largest pump. If the lift is 25 ft., a larger pump than those tested should be used with such a tractor, for the fuel consumption would be about 50 % greater than that for the 50-ft. lift.

To lift 10 feet, the tractor with the largest pump consumed 1.22 gallons of fuel per acre-foot. With a much larger pump designed for a low lift, less fuel would have been consumed. In tests with a 5HP. engine, driving a 3-in. and 5-in. pump respectively, the fuel consumption was about 1.7 gallon per foot acre-foot.

These results indicate the necessity for careful designing of pumping plants and proper operation of the plant after it is installed.

337 - Review of Patents.

Tillage Machines and Implements.

France	485 428	Plough.
Switzerland	76 642	Tilling machine.
United Kingdom	110 729	Motor-cultivator.
	111 264	Motorplough.
United States	1 246 388	Cylinder harrow.
	1 246 462	Centre pressure device for disk harrow.
	1 246 851	Plough.
	1 246 916	Harrow tooth holder.
	1 247 018 — 1 248 517 — 1 249 178	Stalk cutters for maize.
	1 247 013 — 1 249 450	Harrow.
	1 247 170	Motorplough tractor.
	1 247 762	Tool shifting mechanism for agricultural implements.
	1 248 034	Agricultural implement.
	1 248 194	Cultivator.
	1 248 257	Revolving harrow.
	1 248 945	Land roller.
	1 249 103	Attachment for stalk cutter.
	1 249 395	Self cleaning harrow.
	1 249 447	Tractor plough.
	1 249 523	Two-way motorplough.
	1 249 524	Reversible tractor plough.
	1 249 555	Combined harrow and cleaner.
	1 250 013	Gang plough.

Irrigation.

British India	3 201	Gravity water elevator.
Canada	179 444	Ditch plough.
United States	1 218 271	Regulator plough.

Manures and Manure Distributors.

France	485 455	Ammonia produced by catalysis for making simple and complete manures.
United Kingdom	111 254	Method of treating the soil to improve its productivity by means of spraying water heated at 180-210° F.
United States	1 247 001	Attachment for lime spreader.
	1 247 631 — 1 247 703	Manure spreaders.

- 1 247 632 Wide spread attachment for manure spreader.
 1 248 032 Spreader for fertilizer distributor.
 1 248 303 Straw spreader.

Drills and Seeding Machines.

- Denmark 22 475 Potato planter.
 United States 1 247 007 Anchor for check row planters.
 1 247 075 Clutch for maize planter.
 1 247 738 Planting mechanism.
 1 247 744 Combined disk lister and planter.
 1 247 763 — 1 248 351 Seed planters.
 1 248 717 Maize planter.
 1 249 067 Lister plough.

Various Cultural Operations.

- United States 1 246 896 — 1 247 764 Cultivators.
 1 247 246 — 1 248 160 Cotton choppers.
 1 248 040 — 1 249 569 Weeding ploughs.
 1 248 231 Riding cultivator.
 1 248 365 Machine for pulling cotton plants.
 1 248 706 Vineyard disk plough or cultivator.
 1 248 914 Hand cultivator.

Control of Diseases and Pests of Plants.

- France 185 274 Improvements in powdering machines.
 Switzerland 76 646 Trap for rats, mice.
 United Kingdom 111 044 Device for destroying insects.
 111 142 Vermin proof room for preserving fruits.
 United States 1 248 751 Grass and weed cutter.
 1 249 988 Potato bug killer.

Reapers, Mowers and Harvesting Machines.

- British India 3 171 Improvements in or relating to instruments for tapping.
 India rubber producing and like latex yielding plants.
 Canada 179 060 Sheaf carrier.
 179 090 Grain binder.
 179 277 Sheaf shocker.
 179 297 Harvester mechanism.
 Switzerland 76 644 Cherry picker.
 United Kingdom 111 052 Reaping and mowing machine.
 United States 1 246 234 Gang lawn mower.
 1 246 951 — 1 246 963 — 1 247 005 — 1 247 943 — 1 249 935 Sheaf
 machines.
 1 247 070 — 1 249 914 Harvesters.
 1 247 387 Cotton picking machine.
 1 248 591 Corn husking machine.
 1 249 295 Seed gathering attachment for mowers.
 1 249 445 Peanut harvester.

Machines for Lifting Root Crops.

- Denmark 22 464 Tool for topping and lifting turnips by hand.
 22 560 Combined potato digger and elevator.
 22 616 Turnip topping and lifting machine

- ited States 1 246 811 Beet harvester.
 1 247 813 Potato digger.
 1 248 330 Beet topping machine.
 1 248 379 Beet digger.
 1 249 911 Frame for beet harvesting machine.

Threshing and Winnowing Machines.

- ada 179 093 Grain cleaner.
 179 105 Grain grader and cleaner.
 ited States 1 246 949 Grain saving device for threshing machines.
 1 249 663 Feeder for grain separators.
 1 249 966 Grain separator.

Machines and Implements for the Preparation and Storage of Grain, Fodder, etc.

- irish India 3 178 Rice huller.
 mark 22 476 Straw binder.
 22 568 Combined straw gatherer and binder.
 ited Kingdom 110 556 — 111 307 Baling presses.
 ited States 1 246 569 — 1 246 759 — 1 248 753 — 1 249 505 Hay presses.
 1 246 994 Stacker.
 1 247 233 Hay gathering and baling machine.

Steering and Traction of Agricultural Machinery.

- anala 179 228 Wagon mechanism.
 nited Kingdom 111 242 Caterpillar tractor.
 nited States 1 246 443 Tractor wheel.
 1 246 603 — 1 249 996 Tractors.
 1 246 777 Whiffle tree.
 1 247 073 Traction machine.
 1 248 036 Tong truck.
 1 248 599 Steering device for tractors.
 1 248 693 — 1 249 059 Farm tractors.
 1 249 166 Caterpillar tractor track.
 1 249 424 Draft connection for tractor.

Feeding and Housing of Livestock.

- ited Kingdom 110 853 — 111 214 Horse shoes.
 ited States 1 246 751 Collapsible hog feeder.

Poultry Farming.

- itzerland 76 645 Transportable poultry house.
 ited Kingdom 111 208 Incubator.

Rice Keeping.

- ited Kingdom 110 834 Device for uncapping honey combs.

Industries Depending on Plant Products.

- ish India 3 130 Improved method for preparing potato meal.
 3 133 Improved sugar cane grinding mill.
 iterland 76 680 Grinding machine and plates.
 76 892 Fruit and vegetable dividing machine.

Dairying.

Canada	179 217	Cream separator for milk bottles.
	179 270	Bearing for milk separators.
Denmark	22 488	Apparatus for warming or cooling milk by regeneration.
	22 625	Driving mechanism for milk pasteurising apparatus.
Switzerland	76 936	Churn.
United Kingdom	110 621	Cheese (curdling of milk).
	111 341	Process for preparing milk powder.
United States	1 246 292	Teat cup for milking machine.
	1 249 345	Milking machine.

Farm Buildings and Equipment.

United States	1 246 281	Silo.
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Various.

British India	3 207	Single or double suction foot pump.
United Kingdom	110 641	Centrifugal pump.
	110 851	Wind motor.

RURAL ECONOMICS.

338 - **Size of Farm Business.** — JOHNSON, O. R. and FOARD, W. E., in *University of Missouri College of Agriculture, Agricultural Experiment Station Bulletin No. 140*, pp. 1-40. Columbia, Missouri, April, 1917.

This study of the size of farm business was made by means of a Farm Management Survey in the Western part of Johnson County, Missouri.

The farm management method of securing data includes the obtaining of estimates of all receipts and expenses on each farm in a district or region, for a year, and the investment at the beginning and close of the year. Data are secured concerning methods, practices and social conditions of the region. The incomes of all farms are then ascertained and certain factors which have to do with the success of the business are calculated. Then the farms are grouped according to size, capital, labour income and other factors.

The Region Studied. — The region selected for this study which includes four townships in the western part of Johnson County, is typical of a large section of the State. The soil, climate, railways, roads, markets, land values, size of farm, and type of farming are similar to those found in many sections of central Missouri. The average crop yields for the region in 1912 were: maize, 35.4 bushels per acre; wheat, 17.8; oats, 28; hay, 1 ton. The average price of maize, was 45 cents, wheat 85 cents, oats 35 cents and hay \$ 12.

Size of farms, their percentage distribution and proportion of tillable land. — The farms used were first divided according to number of acres operated; the percentage of tillable and pasture land, and of waste land as shown in Table I. This gives a general idea of the distribution of the farms in the size groups. The average size of the farms of the region was 137.8 acres

TABLE I. — *Percentage distribution of farms by size and proportion of tillable land.*

Size group — acres	Farms —	% of total	Tillable land — %	Pasture land — %	Waste — %
< 40	47	7.0	82.2	26.1	6.0
41-80	149	22.3	86.9	32.1	5.6
81-120	151	22.6	89.5	31.3	5.0
121-200	191	28.6	86.4	33.5	3.5
201-400	106	15.9	84.5	37.5	3.2
> 400	24	3.6	81.1	47.1	2.7
Total	668	100.0			

The distribution of investment in the various groups is shown in table II. The proportion of investment in real estate increases on the larger farms. Under present conditions the market value of land is gradually increasing but the man on the small farm gets less benefit from its increase in value than the man on a large farm, because a smaller percentage of this total capital is invested in real estate.

TABLE II. — *Distribution of Investment on 668 Farms.*

Size group	Farms	Real estate	Machinery	Live stock	Supplies	Cash	Total
< 40	47	76.6 %	3.3 %	16.9 %	2.2 %	1.0 %	100
41-80	149	78.9	2.5	15.5	2.0	1.1	100
81-120	151	81.8	2.2	13.5	1.7	0.8	100
121-200	191	81.3	2.2	13.7	2.2	0.6	100
201-400	106	83.2	1.9	12.3	1.8	0.8	100
> 400	24	83.6	1.6	11.9	1.7	1.2	100

Table III gives the number of various classes of livestock, horses, cows, brood sows, and total animal units (1), on the farms of different sizes, the crop acres per animal unit and the efficiency with which the farmer uses his own labour and equipment on the various sized farms. The operator on a small farm grows 15.9 acres of crops for each workman, 7.3 crop acres for each work horse and 20.9 crop acres for each hundred dollars invested in farm machinery. Against this the 201-400 acre farmer grows 67 acres of crops for each workman, nearly 17 acres for each horse and 35 acres for each 100 dollars worth of machinery. The workman has multiplied his

(1) DEFINITION OF TERMS. An *Animal unit* is a horse, cow, five mature hogs, or seven mature sheep; two young animals are regarded as equal to one mature animal of the same kind, on the basis of feed and manure produced. This unit is only approximate at best.

A *productive work unit* is a 10 hour day of productive work, done by either a man or horse. It includes work on live stock, on farm crops, or on the improvement of land; it does not work stock, on the repairs of fences, buildings, and machinery; or on anything not included in the maintenance of the farm.

A *crop index* of 97 simply means that the yield per acre of all crops on this farm or group of farms is 97 % as great as the average yield of the groups of the region.

Labour income is the farmer's net return after paying from his gross income all general running expenses, including also interest at 5 per cent, depreciation, and wages for hired labour and members of his family, but excluding household expenses. (Ed.)

efforts by four, the work horse has doubled the amount of work which he does, and the cost of using equipment has been reduced by nearly half. This will explain in part some of the results which will be given later.

TABLE III. — *Animal Units, Labour Equipment and Size of Farms.*

Size group	Horses	Cows	Sows	Total animal units	Crop acres per		Average size acres	Crop acres per		
					animal unit	animal unit except horses		Man	Horse	8 100 equipment
< 40	2.3	2.8	1.0	4.8	3.48	6.68	26.6	15.9	7.3	20.6
41-80	3.5	2.4	1.8	10.6	3.29	4.13	64.6	25.9	8.4	22.0
81-120	4.2	3.0	3.8	13.4	4.47	6.52	103.3	49.2	14.3	33.0
121-200	5.8	4.6	3.1	21.0	4.20	5.81	159.2	58.9	15.3	33.1
201-400	8.0	6.6	5.7	31.8	4.25	5.68	243.5	67.7	16.9	35.1
> 400	10.4	14.9	10.5	53.8	3.88	4.84	459.6	77.2	21.2	35.5

The same general condition is shown in Table IV, giving the number of productive work units (1) per man and horse on farms of various sizes. This table shows that the man on the smallest farm does about a third as much work as the man on the farm of the next size, while the horse on the larger farm does one and a half times as much as the horse on the smallest farm. The labour income varies in the same direction.

TABLE IV. — *Productive Work Units and the Size of Farms.*

Size group	Average size acres	Work units		Labour income
		per man	per horse	
< 40	26.6	65.4	32.0	8 146
41-80	64.6	110.3	31.0	227
81-120	103.3	148.7	43.5	313
121-200	159.2	167.1	44.3	525
201-400	243.5	213.0	48.2	711
> 400	459.6	171.5	48.8	999

In Table V it will be found that the receipts per acre decrease as the farm increases in size up to the 120 acre farms, above that there is practically no variation. The farmer on 64 acres has about as much expense and about the same receipts per acre as the man on the 240 acre farm. This gives them about the same net income per acre. When this net income is multiplied by the number of acres operated, it is understood why the large farmer gets the larger labour income.

In comparing crops yields it is found that except for the 26.6 acre farm the yields gradually increase as the size of farm increases. This is shown in Table VI, the crop index (1) being the average yield of all crops in terms of per cent; the average yield of four of the more important crops higher on the larger farms.

(1) See notes page 381.

TABLE V. — *Size of farm and Receipts and Expenses per Acre.*

Size of group	Receipts		Expenses		Net income per acre
	per farm	per acre	per farm	per acre	
< 40	\$ 463	\$ 17.40	\$ 195	\$ 7.30	\$ 10.10
41-80	905	14.00	410	6.30	7.70
81-120	1 177	11.40	465	4.50	6.90
121-200	2 124	13.30	980	6.10	7.20
201-400	3 224	13.30	1 480	6.10	7.20
> 400	6 216	13.60	3 270	7.10	6.50

TABLE VI. — *Crop Yields and Size of Farms*

Size of group	Farms	Average size acres	Labour income \$	Crop index %	Corn, bushels per acre	Wheat, bushels per acre	Oats, bushels per acre	Hay, tons per acre
< 40	47	26.6	146	100.74	32.8	16.9	0.0	1.2
41-80	149	64.7	227	92.3	31.9	18.2	25.4	1.15
81-120	151	103.3	313	92.9	34.1	16.2	25.7	0.98
121-200	191	159.2	525	101.2	30.3	16.5	25.8	1.14
201-400	106	243.5	711	102.5	36.8	17.5	31.6	1.05
> 400	24	459.6	997	110.4	38.0	21.9	34.9	1.06

TABLE VII. — *Income and Size of Farms.*

	< 40 acres \$	41-80 acres \$	81-120 acres \$	121-200 acres \$	201-400 acres \$	> 400 acres \$
<i>Capital:</i>						
Land	1 872	4 230	6 320	10 068	17 192	32 561
Machinery	80	133	176	266	387	586
Livestock	414	830	1 070	1 687	2 525	4 618
Supplies	56	108	130	257	380	682
Cash	25	61	68	112	175	494
Total capital	2 247	5 362	7 682	12 390	20 659	38 939
<i>Receipts</i>						
Crops	51	118	188	357	680	1 289
Stock	132	306	390	870	1 214	3 161
Stock products	60	103	122	181	183	161
Miscellaneous	119	149	164	296	443	490
Increased inventory	101	229	313	420	704	1 115
Total receipts	463	905	1 177	2 124	3 224	6 216
<i>Expense</i>						
General	131	282	331	623	1 040	1 781
Stock	45	80	92	277	376	1 337
Decreased inventory	19	48	34	80	64	152
Total expense	195	410	465	980	1 480	3 270
Farm income	268	495	712	1 144	1 744	2 946
Interest on invest- ment	122	268	399	619	1 033	1 947
Labour income	146	227	313	525	711	999

The results shown in the foregoing tables must lead to the conclusion shown in Table VII, giving the capital, receipts, expenses, and labour income

of the various groups. The farmer on the 26 acre farm has only \$ 2447 capital and gets a farm income of \$ 268. The farmer on the next group has \$ 5362 capital and gets a farm income of \$ 495. The farm incomes gradually increase until the larger farm is reached where the farm income is almost \$ 3000, giving a labour income of approximately \$ 1000.

Table VIII shows in a different way the relative profitability of labour put in on live stock and also on cash crops, on the various sized farms.

TABLE VIII. -- *Returns per Days' Work on Crops and Stock Sold.*

Size of farm	Work done		Crop receipts		Net stock receipts	
	Crops Days	Stock Days	Total \$	Per day \$	Total \$	Per day \$
< 40	9.90	99.70	38.90	3.93	140	1.41
41- 80	23.50	159.40	109.80	4.67	323	2.03
81-120	38.27	244.93	171.00	4.49	505	2.06
121-200	65.82	312.18	326.00	4.96	812	2.05
201-400	128.70	458.65	733.00	5.70	1 056	2.30
> 400	177.90	539.70	1 278.00	7.18	3 228	4.13

The table in general shows a gradual increase in wages per day's work from the small to the large one. In preparing this table, all labour on crops sold was charged to crops, and all labour that was put in crops that were fed was charged to the live stock, after the labour of growing crops for work stock and the crops fed work stock was taken out of the total.

In general it shows that the farmer received half the wage in handling live stock that he received for growing cash crops. This does not mean, however, that he should devote all his efforts to growing cash crops, he lends emphasis to the fact that while a cash crop is often more profitable than a crop fed to live stock, when figured in terms of daily wages, yet the live stock enterprises will furnish labour throughout a much greater portion of the year, thus making the total wage at the close of the year much larger. A man is kept busy with his live stock during rainy weather and in winter when cash crops will furnish no labour at all. It can readily be seen from this table, however, that it will probably give him a more desirable system to have some cash crops in combination with live stock enterprises.

Table IX gives the net receipts from crops and stock and their percentage distribution between the various crops and various classes of stock.

TABLE IX.

Size of farm	Farms	Net receipts from		Percentage from crops	Corn	Wheat	Oats	Hay	Cattle	Hogs	Sheep
		Crops	Stock								
		\$	\$	%	%	%	%	%	%	%	%
< 40.	47	82	174	32.0	74.5	25.5	0.0	0.0	31.6	33.6	0.0
41- 80.	149	187	393	32.3	39.1	52.4	3.0	5.5	29.0	42.6	3.0
81-120.	151	284	561	33.7	31.6	62.0	1.6	4.8	29.0	49.0	2.0
121-200.	191	461	912	33.5	17.8	74.8	2.3	5.2	37.3	45.6	2.3
201-400.	106	903	1 285	41.3	16.0	77.8	0.6	5.6	32.3	53.0	5.3
> 400.	24	1 386	2 610	34.7	8.5	74.0	1.5	16.0	40.2	50.8	3.0

As the size of farm increases, the importance of corn as a money crop decreases and the importance of wheat and hay increases. In general as the size of farm increases the importance of cattle and hogs increases also, but the receipts from hogs increase more rapidly than the returns from cattle. In the first three groups, the returns from cattle are in the form of dairy products almost entirely, while on the larger farms the returns are often in the form of beef, dairy products being of less importance. Considering the social side of the farm business, on various-sized farms, some interesting facts were brought out. The family living on the small farm costs about \$62 per person, while on the large farm \$104 a person is spent. The large farmer spends more than four times as much for religious purposes as does the small farmer. The relative importance of cash expenses, produce, and other expenses of family living does not differ widely on the small and the large farm. Of the family living expense, 57 per cent. is a cash item; about 40 per cent. is produce furnished by the farm and the remainder is miscellaneous expenses.

After this discussion of the farm business measured by the number of acres farmed, the writers turn to the study of the influence of various amounts of capital invested on the labour income in the various groups. The following facts were brought out from this study. The labour income, on a certain sized farm, is limited by the capital investment. Some farms are too heavily capitalized and others do not have enough capital invested. The most successful farms in each group have an investment of from \$70 to \$95 per acre. The farmer with a low capital investment (\$54 per acre) sells more crops (50.3 % of receipts from crops) and gets lower yields (94.3 % crop index) than either of the other classes. The man with too high an investment per acre (\$148 per acre) does not sell enough crops (73.3 % of receipts from crops), nor are his yields high enough to warrant his excessive investment (106.3 crop index); consequently his labour income is low. The man with a low capital investment per acre, does not keep much livestock and gives most of his time to crops. The man with a high capital investment per acre, is fairly heavily stocked and gives only about half his time to crops. The farmer who is making the best income gives about 60 per cent. of his time and about 94 per cent. of his horses' time to the production of crops.

The man with a low capital investment per acre, is giving so much attention to grain farming that his system does not give him enough productive labour. Where the capital is larger, the farmer is able to keep more livestock and thus secure more regular employment. This influences his labour income to quite an extent.

The work horse works harder on the farm with less capital per acre, but this difference in the amount of work which the horse does, does not offset the other advantages of the diversified or stock farming system, which the man with more capital is able to practice on a given area.

Considering the value of land it was found that the value per acre of land does not vary uniformly with the productivity of the soil. The yields increase as the value per acre increases up to \$60 to \$80 land. Above this

point the increase in yield in much less rapid than the increase in market value. The labour income reaches its highest point on the \$60 to \$80 land. After that the income begins to fall.

The profitableness of a certain farm is also influenced by the amount of productive labour done. It is easily possible for a 160-acre farm to support no larger business than an 80-acre farm. A system which furnishes from 2 to 2.3 days productive man labour per acre pays the largest labour income.

The profitableness of a certain-sized farm is also effected by crop yields. The labour income on a farm increases uniformly as the crop yield increases.

339 - **Government Lands, Leased Lands and Alienated Lands in Australia.** - *The Pastoral Review*, Vol. XXVII, No. 12, pp. 1137. Melbourne, December 15, 1917.

According to official returns there were to the end of June, 1916, in Australia, 105 422 000 acres of land belonging to private owners, while a further 56 096 000 acres were in process of being sold by the Government to private owners.

Then there were 893 054 000 acres leased, or held under various forms of tenure, and 849 159 000 acres of vacant Government lands, including road and reserves. The position in each State is as follows: -

	Fully Alienated. Acres	Alienation Proceeding. Acres	Leased. Acres	Unoccupied. Acres
1 New South Wales	40 363 316	19 409 656	118 865 868	19 415 530
2 Victoria	24 256 222	8 075 653	13 035 612	10 878 273
3 Queensland	16 447 382	10 776 793	332 824 905	69 070 920
4 South Australia	10 590 756	2 943 395	115 396 433	114 314 216
5 West Australia	8 125 629	13 584 076	196 772 098	406 106 997
6 Tasmania	5 125 197	1 225 924	1 939 905	8 486 571
7 North Territory	474 590	—	113 926 627	220 715 583
8 Fed. Territory	38 961	80 979	292 690	171 030
Australia	105 422 053	56 096 476	893 054 138	849 159 173

340 - **Machine Sheep-Shearing and Lack of Labour in New Zealand.** - BRUCE, J. L. in *The Journal of Agriculture, New Zealand Department of Agriculture, Industries and Commerce*, Vol. XV, No. 3, pp. 134-135. Wellington, September 20, 1917.

Most of the New Zealand owners of sheep realise the advantages of the mechanical shearer, which permits shearing to be carried out more rapidly and more perfectly. Under present conditions it is becoming more and more difficult to find good shearers, and it is especially the small owners who meet with the greatest difficulties. The problem to be solved is whether it is advantageous for each herd owner to possess a mechanical shearer. The co-operation of small owners for the use of one mechanical shearer, as has been advocated, though perfect in theory, is not easy in practice. Each owner of at least 200 sheep should have his own mechanical shearer. Such an apparatus, with a 1 ½ HP motor costs £ 110 (motor, £ 50, plant £ 60). As the use of a machine allows, at the first shearing a wool surplus which the author estimates at £ 10, and as the value of wool is now 55 % higher than it was in 1913-1914, a yield of from 8 lb. to 9 lb.

would pay half the cost of installing the machinery from the first season. A larger motor, preferably of 4 HP, would be more satisfactory, even for a small herd, for besides shearing, it could also be used for working a chaff-cutter, a pump, etc.

The reduction of labour is of the utmost importance in the present crisis, and in New Zealand, which is essentially agricultural, mechanical shearing is sure to play an important part.

AGRICULTURAL INDUSTRIES.

341 - **The Autolysis of Yeast and the Influence of Its Products of Proteolysis on the Development of Yeast and Lactic Bacteria.** — VANSTEENBERGE, P., in the *Annales de l'Institut Pasteur*, Vol. XXXI, No. 12, pp. 601-630, Tables VII. Paris, December, 1917.

Experiments made by the author at the Microbiological Laboratory of the Higher Technical School of Delft (Holland), using: — 1) pressed beer and distillers' yeast; 2) various lactic ferments. The following results were obtained:—

After the death of the yeast cell, it loses its water, becoming much smaller. When the dead yeast has retained its fermentative, especially its proteolytic, activity, the yeast "liquefies", after a time varying with the temperature. The optimum temperature for the endotryptase is from 45-50° C. and the maximum at 53° C. The optimum for autolysis of the living yeast tested was from 48-50° C.

The increased acidity to litmus or phenolphthalein up to a certain fixed degree and the crystallisation of the tyrosine may be taken to show the good progress and end of the autolysis.

Yeast water, obtained by boiling fresh yeast in water, only contains $\frac{1}{3}$ of the total nitrogen of the yeast. A preliminary autolysis for 23 hours at 48 to 49° C., changes all the nitrogen into soluble nitrogen not coagulable by heat. Autolysed yeast water is a better food for yeast and lactic bacteria than yeast water obtained by simply boiling. Apart from the quantity, the quality of the nitrogen is greatly improved by autolysis.

In autolysed yeast water of the strength of 20 gm. of yeast to 100 cc. of water, there are products that are unfavourable to the growth of the yeast; this harmful influence is removed on dilution.

Amongst substances acting in this way, tyrosine and leucine may be considered as two of the chief products of autolysis.

Leucine is still favourable at the strength of 0.08 gm. %, but completely stops development at 0.66 gm. %. Tyrosine is favourable up to 0.05 %, but beyond that strength is harmful. Asparagine as harmful beyond 1 %.

These products, though harmful to yeast at the strength at which they occur in autolysed yeast water, have no unfavourable influence on the lactic ferments even at the same strength.

The value of autolysed yeast water is due to a mixture of proteolytic products, the chief of which is peptone, and where small quantities of a series of substances, including leucine, asparagine and tyrosine, favour,

independantly of the yeast, the growth of the yeast and of the lactic bacteria.

The value of extract of malt is probably due to the presence of a series of proteolytic products similar to those in autolysed yeast (1).

342 - **The Milling and Baking Qualities of Australian Wheat.** — SCOTT, P. RANKIN and WINSLOW, F. G. B., in *The Journal of the Department of Agriculture of Victoria, Australia*, Vol. XV, Pt. 8, pp. 474-481, 1 diagr., 3 figs. Melbourne, August, 1917.

Wheat growing is one of the most important industries of Australia. New South Wales, South Australia, Western Australia and Victoria produce about $4\frac{1}{2}$ times their own requirement in wheat. In order to control the wheat exported each year the Corn Section of the Chambers of Commerce of the four above-mentioned states fixes a standard of quality, called "fair average quality" or "F. A. Q. standard" which is representative of the quality of wheat produced each year. The standards fixed correspond to the quantity available, an average of 135 000 000 bushels, the yield from the separate States being: — Victoria, 50 000 000 bushels, South Australia, 40 000 000 bushels, New South Wales, 31 500 000 bushels, and Western Australia, 13 500 000 bushels (These totals do not include the quantities set aside for sowing and the feeding of poultry). The amount estimated for home consumption is 30 000 000 bushels, leaving, in normal years, 105 000 000 bushels for export, either as grain or as flour.

In order to ascertain the variations in quality due to climatic conditions during the period of growth experiments were carried out: — 1) to determine the amount of impurities and the proportion in which the various ingredients are present; 2) to classify the wheat according to size and determine the proportion of the various ingredients of each size; 3) to determine the unit weight per volume of original wheat and cleaned wheat; 4) the milling capacity; 5) to determine the gluten content, strength and colour of the flour; 6) its baking qualities.

The chief results are given in the appended tables. Table I shows that in one year, about 24 000 tons of impurities are exported mixed with the original wheat; if only cleaned wheat were exported the cost of shipping would be proportionately reduced; moreover, this quantity could be advantageously used in Australia for feeding cattle. The average percentages of impurities found in the wheats analysed during the four years 1912-13 to 1916-17 were: — New South Wales, 0.52; South Australia, 1.03, Western Australia, 0.59; Victoria, 1.01.

The measurements of the grain given in Table II are of importance in milling, where large, well-developed grain is preferred, as, the more uniform it is, the better does it mill. For most varieties, the larger the grain, the higher is the yield in flour. This does not always apply to a composite sample, as the bran layer is thicker in some varieties than in others. It would be very advantageous to sift the grain before exporting it, so as to

(1) As regards the use of artificial cultures of yeasts for making forage albumen, see *B.* November, 1915, No. 1201. (Ed.)

remove broken or shrivelled grain, the quantity of which was estimated at 12 408 tons, or 4.35 % of the yield, in 1916-17.

The results of the milling tests, given in Table III, show that the amount of water required to condition the wheat was greater than usual, the duration of the operation rather less. The wheats of South and Western Australia gave a high percentage of flour, those of New South Wales and Victoria, a low one. The colour of the flour of all the states was much below the average. None of these wheats can be considered of first quality as regards gluten content or water absorption capacity.

TABLE I. — *Amount (in grams) of foreign matter and unthreshed heads in Australian Wheat (1,000 grams taken).*

State	Rocky	Chaff	Drake	Oats	Rut-bush	Smut	Stem	Whitechaff	Wild Oats	Wild Seeds	Per cent.	Unthreshed heads per cent.
New South Wales	0.48	1.52	0.05	0.56	0.52	0.12	0.07	0.19	0.48	0.14	0.413	2.04
South Australia	2.41	1.47	2.34	0.36	0.84	0.79	0.38	0.38	0.14	0.14	0.025	0.62
Western Australia	2.67	1.73	1.40	0.31	0.34	0.09	0.06	1.29	0.06	0.04	0.805	0.40
Victoria	1.79	2.98	2.23	1.84	0.48	0.22	0.28	0.61	0.33	0.27	1.103	1.59

TABLE II. — *Amount of grain (in grams retained on sieves of varying mesh (1000 grams taken).*

State	Size of mesh						Screenings under 2.00
	3.25	3.00	2.75	2.50	2.25	2.00	
New South Wales	9.5	75.5	122.5	407.0	224.0	107.0	54.0
South Australia	13.5	203.5	280.5	333.0	65.5	14.0	30.0
Western Australia	5.0	198.5	325.5	358.5	74.0	17.5	21.0
Victoria	4.0	102.0	199.0	442.5	118.5	45.5	28.0

TABLE III. — *Results of milling tests of F. A. Q. samples 1916-1917.*

State	Cleaned wheat Bushel weight lbs.	Dirty wheat Bushel weight lbs.	Break flour per cent.	Flour per cent.	Bran per cent.	Pollard per cent.	Colour 20 points max.	Strength quart water 200 lbs. flour	Wet gluten per cent.	Dry gluten per cent.	Moisture content Wheat per cent.	Moisture content Flour per cent.
Victoria	64.7	60.25	7.5	69.2	17.2	12.6	15.5	17.0	19.25	7.11	11.70	13.06
South Australia	64.9	62.00	6.4	73.7	16.3	10.0	15.5	47.6	19.66	6.70	11.34	13.07
New South Wales	60.9	56.75	5.4	68.6	21.0	10.4	14.5	44.3	18.82	7.00	11.53	13.06
Western Australia	67.1	62.75	3.6	74.9	17.4	7.7	17.0	49.9	22.9	8.01	10.38	12.30

The advantages to Australia of exporting flour instead of wheat are pointed out; they are a saving of $\frac{1}{3}$ of the tonnage, the home use of the residue and by-products, the encouragement of the national industry.

343 - **The Soluble Nitrogenous Matter as an Index of the Baking Quality of Flour.** - ROUSSEAU and SIROT, in *Comptes rendus des Séances de l'Académie des Sciences*, Vol. CLXVI, No. 4, pp. 190-192. Paris, January 28, 1918.

In 1913 the authors showed that, to an appreciable extent, it was possible to estimate the baking quality of flour by the ratio of the total nitrogen to the nitrogen soluble in water (1). They continued their study with different samples, considering the inverse ratio, which seemed preferable.

I. NORMAL FLOUR. — 1) *Flours of a bolting degree inferior to 70 %*. — The proportion of soluble nitrogen was about 17 % of the total nitrogen with a minimum of 16.1 % and a maximum of 19 %.

2) *Flours bolting over 70 %*. — The proportion of soluble nitrogen decreases as the bolting degree increases; proportions between 16.6 and 18.1 represent the best baking qualities.

3) *American flours*. — Many American flours very rich in gluten have a proportion of soluble nitrogen between 12.5 and 12.8 %. The addition of such flour improves native flours which "relâchent" (2), in which the ratio of soluble nitrogen to total nitrogen is very high; such addition lowers the ratio, making it almost normal.

II. ABNORMAL FLOUR (giving rise to difficulties in breadmaking). — The proportion of soluble nitrogen is above 20 %, more often about 22 %; it even rose to 62.5 % in a flour which had been stored a long time.

III. VARIOUS FLOURS. — The values found for the ratio soluble nitrogen: total nitrogen were: — maize, 18.1 and 18.5; rye, 22.7, 22.2 and 22.7; bean, 12.1; barley, about 12.1; rice, 4.27 and 4.20; one sample gave 2.5, another, although old, only 5.7.

The use of lime water in breadmaking (method of Messrs. LAPICQUE and LEGENDRE (3)) has a solvent action on the nitrogen and brings the proportion of soluble nitrogen of flours with a high bolting degree down to the normal.

The results may be summarised as follows: —

The presence of a certain percentage of soluble nitrogen in flour usually corresponds to a good absorption of water, and, consequently, to good kneading qualities of the dough, which is one of the most important qualities. The most advantageous proportion of soluble nitrogen to total nitrogen is about 16 to 17 %. If it rises or falls too much the flour will "relâche" and becomes of bad breadmaking quality. If the total nitrogen content is very high the flour is very hard to work.

The ratio of soluble nitrogen to total nitrogen, which is easily determined, can, therefore be of practical use in estimating the breadmaking qualities

(1) See B. May, 1913, No. 605. — (2) This term is applied to flour, usually made from badly harvested grain, which, after kneading, and when left for a time before being placed in baskets, gives out water which rises to the surface. The baker is obliged to add more flour and re-work the dough, thus obtaining less bread and a product of inferior quality. — (3) See R. Fgb., 1918, No. 216. (Ed.).

of flour, not as an absolute criterion, but as a useful indication, especially when other analytical characters are lacking.

- 344 - **The Use of Chalk in Breadmaking.** — EFFRONT, JEAN, in the *Bulletin de la Société scientifique d'Hygiène alimentaire et d'alimentation rationnelle de l'homme*, Vol. V, No. 8, pp. 437-446. Paris, 1917.

In opposition to Messrs. LAPICQUE and LEGENDRE (1) who assert that the use of chalk inhibits the action of the soluble ferments contained in bran, which cause the acidification of bread, the author maintains that this acidity is not the result of enzyme action. The germinated grains may be treated with alkalis and acids in quantities 20 times higher than those at which enzymes in solution are destroyed without losing any of their active substances. Similarly, the soluble ferments of flour diluted in water can bear a temporary change in the reaction of the medium without any change occurring in the enzymes they contain. Sharps treated with chalk and then diluted in a mixture of flour and water keep all their active substances which, moreover, have no harmful effect on breadmaking.

The acidity of the flour, bad smell, bad keeping quality and the tendency of bread to go mouldy are not due to the enzymes of the bran, but to bacteria derived from insufficient cleaning of the grain and the presence of a large quantity of bran, the bacterial flora of which is richer than that of flour. The addition of 40 centigrams of chalk, as advocated in the new method, has no favourable action on the acidity, keeping qualities, or colour of the bread. In the presence of a fresh, strong yeast the amount of chalk advised has no action on the fermentation process. If the yeast is unsatisfactory, the introduction of chalk is certainly harmful.

Everything goes to prove that chalk bread is less easy to digest than ordinary bread, since the mono and tribasic phosphates, so favourable to salivary digestion, are replaced in the new bread by insoluble tribasic phosphates which have no influence on the very important first stage of digestion.

- 345 - **Tapioca Starch Made in Rhodesia.** — See No. 254 of this Review.

- 346 - **Copra Driers in Jamaica.** — WATES, L. A. in *The Journal of the Jamaica Agricultural Society*, Vol. XXI, No. 11, pp. 453-454. Kingston, Jamaica, November, 1917.

The increased production of copra in Jamaica has led to a large increase in the number of drying houses. During the last few years copra making has been carried out on a small scale on most estates, where, in nearly all the cases, it was dried on trays exposed to the sun. Today, practically every estate of any size has a drier. These driers are made on the model of that perfected by Mr. ED. ASHMAN at Boroughfield for drying cocoa. They consist of a practically air-tight wood or stone building, varying in size, containing a more or less large number of trays, heated by a furnace or stove, built in the wall, to which is attached a series of hot air pipes which

(1) See R. February, 1918, No. 216. (Ed.)

acts as a chimney or draught. A ventilator is let into the roof to regulate the heat.

Although all these driers are built more or less on the same lines, the details of their construction vary. Sometimes an ante-chamber, also practically air-tight, precedes the drying chamber. The trays are usually made of half-inch mesh wire on frames. The furnace of the best houses is so placed that the heating pipes start from about the level of the floor.

As a result of the different drying methods the quality of the copra produced also varies greatly, and often leaves much to be desired. The following technical points should be observed in drying the nuts and preparing the copra.

- 1) a white, pellucid copra, containing not more than 5 % moisture should be aimed at;
- 2) the split nuts should be exposed in the sun for half a day or so before use;
- 3) the nuts should be kept in the drier at an initial temperature of from 160 to 170° F. for at least 12 hours;
- 4) suitable ventilation for removing the moisture;
- 5) final desiccation at 140° F.

A uniform distribution of the heat throughout the building, and constant and regular ventilation are essential to satisfactory drying. Since the hurricane of September, 1917, which blew down a large quantity of nuts, there has been great activity in making copra and further improvements are being made in the driers.

347 - Wax from *Ceroxylon andicolum*. — See No. 254 of this Review.

348 - Note on the Fibre of *Wrightia annamensis*. — CREVOST, C., in the *Bulletin Economique de l'Indochine*, New Series, Year XX, pp. 487-491, figs. 2, plate 1. Hanoi-Haiphong, September-October, 1917.

Wrightia annamensis Eber. and Dub. (fam. Apocynaceae) occurs throughout Indochina; it is commonly called "Cay Long Muc" in Cochinchina, Annam and Tonkin, and "Chhœ u dâykhlà" in Cambodia.

The author quotes the description by EBERHARD and DUBARD of this little tree whose wood resembles that of box. The fibres consist of hairs forming an umbrella round the seed. These hairs are lustrous, silky, wavy and slightly drooping; they are 3 or 4 cm. long, but there are much shorter hairs in the tuft; they taper slightly from the base towards the summit and have an average diameter of $\frac{6}{100}$ to $\frac{6}{100}$ mm. at the base, which is often reduced to $\frac{1}{100}$ mm. at the summit. The wall is as much as 3 mm. thick, but it is usually 1.5 mm. They do not consist of pure cellulose, but of lignified cellulose.

Up to the present, all spinning tests have failed. The author boiled them in a lye to which soap was added (45 litres water, 230 gm. soap, 200 gm. Phenix lye). The product was turned slightly yellow by this bath, and unfortunately much of the natural lustre was lost. The mass of fibres thus treated and carded have the appearance of cottony down; the fibres

are tangled, waved, shrunk in places, and are suitable for spinning on the native wheel. The thread obtained from the spindle seems fairly well conditioned, but downy; spinning is rather delicate, and the thread is not so strong as cotton. Threads twisted together in 3, 4, or 5, gave strength like wool, and resemble soft wool to the touch. They easily dye with aniline colours. When knitted, a fabric is produced having a weight like that of wool, which it closely resembles. Weaving tests are to be undertaken.

The fibres of *Wrightia* might, on account of their cellulose, be used for making explosives.

The plant appears to occur over a large area in Indochina, and it seems to grow more quickly in southern than in northern regions.

PLANT DISEASES

DISEASES DUE TO FUNGI, BACTERIA AND OTHER LOWER PLANTS.

GENERAL

- 349 - **Parasitic Fungi Collected in the Government of Podolia, Russia** (1). — GARBOWSKI, L., in the *Bulletin trimestriel de la Société mycologique de France*, Vol. XXXIII, Pt. 3 and 4, pp. 73-91, figs. 1-4. Paris, 1918.

This is a list of 121 species of micromycetes living parasitically on cereals and other plants, both cultivated and wild, collected in 1915 in various districts of the government of Podolia. Four species are mentioned as being new to science, amongst them *Fusariella Populi*, found on leaves of *Populus tremula*, and *Macrosporium somniferi*, on living leaves of *Papaver somniferum*.

- 350 - **Fungi of Southern China** (2). — YATES HARRY S., in *The Philippine Journal of Science* Section C, Botany, Vol. XII, No. 5, pp. 313-316. Manila, September, 1917.

This paper contains a list of fungi collected by Mr. E. D. MERRILL in Kwantung Province, in October and November, 1916. It includes: —

- 1) *Parodiella perisporioides* (B. and C.) Speg., on leaves of *Desmodium triflorum*, Canton (Honam Island);
- 2) *Trabutia chinense* n. sp., on leaves of *Ficus* sp., Loh Fau Mountain (Lofaushan);
- 3) *Phyllachora Coicis* P. Henn., on leaves of *Coix Lacryma-Jobi*, Canton;
- 4) *Phyll. Cynodontis* (Sacc.) Niessl., on leaves of *Cynodon Dactylon*, Canton;
- 5) *Phyll. orbicula* Rehm, on leaves of *Bambusa Blumeana*, Canton;
- 6) *Puccinia Cynodontis* Desm., on leaves of *Cynodon Dactylon*, Canton;
- 7) *Pucc. heterospora* B. and C., on leaves of *Prunus Persica*, Canton;
- 8) *Uredo cantoniensis* n. sp., on leaves of *Melothria indica*, Canton;
- 9) *U. philippinensis* Syd., on leaves of *Cyperus* sp., Canton;
- 10) *Uromyces linearis* B. and Br., on leaves of *Panicum repens*, Canton;
- 11) *Ustilago Cynodontis* P. Henn., on inflorescences of *Cynodon Dactylon* Canton;

(1) See also R. Sept., 1917, No. 872. (Ed.)

(2) See also B. July, 1912, No. 1099; B. June, 1913, No. 754; B. June, 1914, No. 578. (Ed.)

12) *U. Koordersiana* Bref., on inflorescences of *Polygonum* sp.¹ Canton;

13) *Cercospora personata* (B. and C.) Ellis, on leaves of *Arachis hypogaea*, Canton; this fungus is the cause of a serious disease of the peanut in the West Indies; it has also been reported from the United States (1) and India, and is abundant on the leaves of Leguminosae in the Philippines; it is very similar to, and may be identical with *Septogloeum Arachidis* Rac., which causes a serious disease of peanuts in Java and has also been reported from Ceylon;

14) *Helminthosporium Ravenelii* Curt., on inflorescences of *Sporobolus elongatus*, Canton.

Pseudomonas Citri Hasse is also mentioned as living on leaves of *Citrus* sp. at Canton; this bacterium, the cause of Citrus canker (2) was not found in the material examined, but the general appearance of the infected areas was that caused by this well-known microorganism.

351 - Varieties of Swede Resistant to "Finger and Toe" (*Plasmodiophora Brassicae*), in Denmark. — See No. 282 of this Review.

352 - Varieties of Flax Resistant to *Fusarium lini*, in the United States. — See No. 283 of this Review.

353 - Asparagus Resistant to Rust (*Puccinia Asparagi*), in Massachusetts, U. S. A. — See No. 285 of this Review.

354 - "Minnesota No. 1107" a Variety of Strawberry Little Resistant to Fungous Diseases, in the United States. — See No. 298 of this Review.

355 - Disease Resistant Direct Bearers; Observations in France in 1917. — See No. 303 of this Review.

356 - Chestnut Hybrids Resistant to Canker (*Endothia parasitica*) in the United States. — See No. 286 of this Review.

357 - Patents for the Control of Diseases and Pests of Plants. — See No. 337 of this Review.

358 - *Bacillus atrosepticus*, a Cause of "Blackleg" in Potato in Lancashire, England (3). — PAINE, SYDNEY, G. in *The Journal of Agricultural Science*, Vol. VIII. Pt. 4, pp. 480-494. Cambridge, 1917.

The damage done in Great Britain by potato bacteria is not so extensive as that done in other countries of Europe, the United States, and Canada. The loss caused probably does not exceed 5% of the whole crop of Great

(1) See also R. May, 1916, No. 581, and R. May, 1917, No. 492. (Ed.) — (2) See also B. July, 1915, No. 763 and R. December, 1916, No. 1337. (Ed.) — (3) See B. Nov., 1916, p. 157. (Ed.)

Britain, but it may become more serious at any moment, as certain indications show.

Four or five different bacteria have been described in other countries as causing the disease of potatoes known as "Blackleg", but the cause in England has not yet been identified. The author undertook to determine which of the various microorganisms mentioned actually exist in Great Britain. For his research he used material collected in August, 1916 in the neighbourhood of Ormskirk (Lancashire).

The experiments lead to the conclusion that the bacterium causing Blackleg in Lancashire is *Bacillus atrosepeticus* (van Hall), which the author succeeded in isolating with great difficulty, and the morphological, cultural and physiological characters of which he describes in detail. Infection experiments gave positive results. This bacterium is in every way identical with that considered to cause the same disease in Ireland and described by PETHYBRIDGE and MURPHY under the name of *B. melanogenes*.

359 - Notes on Downy Mildew of the Vine in Australia. — CASTELLA, F. DE and FRITTE-BANK, C. C., in *The Journal of the Department of Agriculture of Victoria, Australia*, Vol. XV, Pt. II, pp. 685-700, figs. 1-2. Melbourne, November, 1917.

Till the summer of 1916-1917 Australian vineyards had not been attacked by downy mildew (*Plasmopara viticola*). The fungus had been reported, it is true, but only in an isolated case, on a private vineyard at South Yarra. The plant was uprooted and burnt and the disease was not again observed in Australia till January 31, 1917. Since then the fungus has appeared suddenly over wide areas of the north-east of Victoria.

As a rule the outbreak was slight. No damage was done and the fungus was not sufficiently in evidence, at least in any of the vineyards affected, to cause apprehension or to make spraying advisable. The origin of the 1917 outbreak is obscure, but there is no doubt that the excessive wetness of the summer was responsible for its development and spreading over so large an area.

It has been suggested, perhaps rightly so, that the grafted resistant rootlings imported from France during the last 10 years have acted as carriers. It is also possible that the fungus was introduced with dried grapes from Spain, Greece and Turkey. It is equally probable that the fungus existed in Victoria for a long time, but that, owing to climatic conditions, the white, downy efflorescence by which it is identified, was unable to manifest itself till the very wet summer of 1916-1917.

A description is given of the outward appearance of the disease, the damage it causes, the life history of the parasite and the methods of control used in Europe.

In normal summers Australian vine-growers, as those of California and the Cape, probably have little to fear from mildew, but the summer of 1917-1918 threatens to be even wetter than the preceding one. Spraying, when necessary, should prove much more efficacious in Australia than in France.

360 - Citrus Diseases in Surinam. — See No. 300 of this Review.

[358-360]

361 - ***Blepharospora cambivora* n. gen. and n. sp., a Cause of "Ink Disease" in Chestnut Trees.** — PETRI, I., in *Rendiconti delle sedute della R. Accademia dei Lincei, Classe di Scienze fisiche, matematiche e naturali*, Ser. 5, Vol. XXVI, Pt. 2 pp. 297-299. Rome, 1917.

In his last report on his investigations into "ink disease" of chestnut trees the author concluded that the causal parasite was a multicellular mycelium of intercellular and intracellular reproduction which remained unicellular for a more or less prolonged period, and formed in the cambium globose and threadlike haustoria. The mycelium, although grown on the most varied media, had always remained sterile (1).

Later investigations enabled the author to cause the formation of spores the characters of which place the parasite among the Saprolegniaceae (Schröter) while bringing it near to the *Pythiaceae* and the *Peronosporaceae*. While waiting to give a fuller description later, the author calls this member of a new genus and a new species *Blepharospora cambivora*.

To produce the disease artificially the mycelium was inoculated into healthy chestnut trees at the "R. Istituto superiore forestale nazionale" at Florence. Isolated trees and those in plantations near infected centres in the province of Cuneo (Mondovì) were used. Of 13 chestnut trees from 5 to 6 years old, planted and inoculated on May 26, 1916, 9 were dead or dying about two months later. The characteristic brown spots of the collar rose towards the epigeal base of the stem and descended towards the most superficial roots. In trees about 60 years old the infection spread in six months from the cambium over about $\frac{1}{3}$ of the whole circumference of the trunk.

In experiments carried out in Piedmont inoculations were made in August 1917, at the base of stems of young, strong shoots of chestnut trees of 10 to 15 years old in the Alma district of Frabosa Sottana (Mondovì). This district had not been attacked, but was next to a centre of infection. On October 2 some of the plants were examined and the infection was seen to have spread over almost half of the circumference of the stem, descending towards the collar. In some cases necrosis of the tissues was shown by a depression and brown coloration of the bark. The characters of the cambium and cortical tissues were identical with those of chestnut trees attacked by "ink disease".

362 - ***Diaporthe taleola*, an Ascomycete Injurious to Oaks, in Switzerland.** — MOREILLON, M., in the *Journal forestier suisse*, Year LXIX, No. 1, pp. 1-3, 1 plate. Berne, January, 1918.

During the second fortnight of September, under a slight wind, oaks *Quercus pedunculata*, *Q. sessiliflora* and *Q. pubescens* of 50 to 150 years old, isolated in coppices, on dry, calcareous soil, not very deep-rooted, to the south-west of the Vaudois Jura (Montcherand, at an altitude of about 1850 feet) lost several of their twigs. In some cases were counted ten branches per square yard, measuring as much as $\frac{1}{2}$ inch in diameter and nearly 6 inches in length representing a premature loss of a maximum of 1% of the twigs of the tree.

(1) See R. Oct., 1917, No. 973. (Ed.)

An examination of these twigs showed their loss to be caused by *Diaporthe taleola* Fries. Similar damage was observed by the author in the copses of Corcelles-sur-Chavornay (1 900 feet), on clay, and at Sauvabelin, near Lausanne (2 030 feet), on molasse. Isolated oaks on the Zürichberg, above the town of Zurich, were also recently found to be attacked by the same fungus. This fungus had already been reported by Dr. von TAVEL in 1903 on the Käferberg, near Zurich, and yet earlier (1893) R. HARRIG had drawn attention to the damage done by the ascomycete to oaks of about 35 years old in Germany and in Austria.

363 - *Chrysomyxa Abietis* in England and Scotland. — HILEY, W. E., in the Quarterly Journal of Forestry, Vol. XI, No. 3, pp. 191-192. London, July, 1917.

On May 15, 1917 in a small wood of mixed trees, south of Ridsdale, Northumberland, were found two spruces badly attacked by *Chrysomyxa Abietis* (Wallr.) Ung. The two trees were growing together and were badly stunted, but this could not be attributed to the fungus as only the leaves of the preceding year were attacked. One tree of normal size also had yellow patches caused by the fungus on some of its lower branches.

The presence of this fungus had not hitherto been reported in England; it was probably introduced from Scotland, where it has been frequently observed of recent years. The first report of the appearance of the parasite came from Aberdeenshire in 1911, where it was found on the estate of Durris, in the Dee valley. Later it was again observed in the same district, and, in 1916, was recorded from Perthshire.

Infection in England probably occurred in 1916, for, though the author could find no trace of the parasite on the 1915 shoots, the two above-mentioned trees were attacked on all the 1916 twigs except those at the top.

WEEDS AND PARASITIC FLOWERING PLANTS

364 - Devil's Fig (*Solanum largiflorum*), a New Weed in Queensland. — WHITE, C. T. in the Queensland Agricultural Journal, Vol. VIII, Pt. 3, pp. 170-172. Brisbane, September, 1917.

This paper gives a botanical description of a new *Solanum* found up to the present in the Kin Kin district, Bundaberg and Childers, but doubtless growing in other districts as well. It has recently been reported as a new pest in the first of the three above-mentioned districts.

The plant was first considered to be a southern form of *S. Dallachii* from which it differs in some respects. It does not seem to agree with any of the extra-Australian species. It is commonly called "Devil's Fig" but is also known as "Chinese Fig." This latter name is undesirable as the plant is native. The aboriginal name "Koori" of the old Bundaberg natives given under *Solanum Dallachii* by F. M. BAILEY (Queensland Flora, p. 1087) belongs to this new species.

If the weeds are few they may be grubbed out; repeated cutting close to the ground exhausts the vitality of the plant, but this treatment

must be persistent to succeed; a little brine or caustic soda and arsenic about the cut surface is useful. Spraying with arsenical solutions does not seem of much value and is out of the question where cattle graze, but the injection of an arsenical solution into the main root or branch should prove successful.

365 - **A Machine for Destroying Weeds.** — See No. 334 of this Review.

INJURIOUS INSECTS AND OTHER LOWER ANIMALS.

366 - **Biological Observations on Some Insects in the Department of Hérault France.** — PICARD, F., in the *Bulletin de la Société entomologique de France*, No. 19, pp. 355-357. Paris, 1917.

Special mention should be made of:

Lixus iridis Ol. — This curculionid, common on aquatic umbelliferae (*Helosciadium* = *Apium*, etc.), is sometimes injurious to celery near Montpellier.

Pieris brassicae L. — Among the parasites of the large white cabbage moth should be included the ichneumon *Pimpla alternans* Grav., which undergoes metamorphosis in the larvae of the macrolepidopteron. Three specimens reared by the author emerged November 30, 1917. It should be noted that this *Pimpla* does not develop in the larva but in the winter chrysalis of *Clysia ambigua*lla.

Pyrameis cardui L. — The larva of this macrolepidopteron was reared on *Parietaria officinalis*.

Charaxes jasius L. — CH. OBERTHÜR doubts the presence of this lepidopteron in Languedoc. It is sometimes, though rarely, found in Hérault wherever the strawberry tree (*Arbustus Unedo*) grows. The author found larvae of the insect on specimens of Ericaceae at the School of Agriculture of Montpellier, and has been assured by all the lepidopteron collectors he has consulted that the adult insect has been taken in the gardens of the town and in several other localities.

Carpocapsa pomonella L. — This tortrix (apple pyralis) lives at Montpellier on the fruit of *Diospyros Kaki*, *D. Lotus* and other plants of the same genus. It did great damage to the crop in 1912 and 1913, a year in which the first generation of the microlepidopteron destroyed almost all the fruit.

Agromyza abies Zett. — This dipteron was reported by P. MARCHAL as damaging artichokes near Perpignan. The author found it at Montpellier in the same plant under the same conditions. The larvae burrow in the leaves, along the veins, longitudinal galleries with very characteristic quadrangular expansions. There are many generations and damage is done in all seasons. The larvae were particularly numerous during the winter of 1913-1914; the exceptional cold of January, 1914, killed the greater part of them. Since then, the species, although it has not disappeared entirely, has become practically harmless.

Scleroderma domesticum Latr. — In the Montpellier Botanical Gardens

this proctotrupid hymenopteron is parasitic on the coleopteron *Phlaeosinus thuyae*, and the adult insect hibernates under the bark of cypress in galleries hollowed by the scolytid.

Myrmecophila acervorum Panz. — This myrmecophilous orthopteron is fairly common in the Department of Hérault. A long list of formicidae (genera *Camponotus*, *Formica*, *Lasius*, *Myrmica*, *Tetramorium*, *Solenopsis*) on which it may live has already been given. To the author's knowledge the gryllid has not yet been reported on members of the *Cremastogaster* genus. It is under bark, especially that of *Pinus halepensis*, in which is *Crem. scutellaris*, that this species of *Myrmecophila* is almost exclusively found, at least in Hérault. It is rarer under flat stones, where the author has found it with another formicid, *Pheidole pallidula*.

367 — **Life History of *Macrosiphum illinoensis*, the Grapevine Aphis.** —

BAKER, A. C., in the *Journal of Agricultural Research*, Vol. XI, No. 3, pp. 83-89, plates 8-9 Washington, October 15, 1917.

A short note on the alternation in food plants by this species was published in 1915 by BAKER and TURNER (1). The aphid was first described by SHIMER in 1866 under the name of *Aphis illinoensis*. Later, in 1879, THOMAS described it as *Siphonophora viticola*, and it was always mentioned under the name of *viticola* Thos., until DAVIS, when listing the aphids of Illinois in 1910, drew attention to SHIMER's description and gave *viticola* Thos. as a synonym of *illinoensis* Shimer.

The species is very abundant on wild grapes (*Vitis* spp.) in the more southern parts of the United States and often damages the cultivated varieties. Specimens of it have been collected in the District of Columbia, Georgia, Indiana, Maryland, Missouri, Mississippi, North Carolina, New Jersey, New York, Oklahoma, Pennsylvania, Texas and Virginia. An aphid which might belong to the same species was found on the vine at Campinas, Brazil, in September, 1898.

As there is no complete study in scientific literature of the different forms of the aphid the author considered it wise, in view of the economic importance of the insect, to record briefly the results of some of the most recent studies on it and to give a full description of the life history of the species.

368 — ***Lepidium apetalum*, the Secondary Host of *Myzus cerasi* in Ontario**

Canada. — ROSS, W. A. *The Canadian Entomologist*, Vol. XLIX, No. 12, p. 434 London, December, 1917.

Among entomologists there is a difference of opinion as to whether *Myzus cerasi* Fabr. (cherry aphid) is migratory. CROSBY considers the question undecided. SANDERSON and O'KANE state that, so far as is known the aphid has only one food plant. GILLETTE states definitely that *M. cerasi* cannot change hosts. On the other hand, QUAINANCE and BAKER claim that the species is migratory.

(1) See *B. Sept.*, 1915, No. 990. (Ed.)

The author's observations lead him to conclude that this aphid is partially monophagous and partially migratory. Apterous forms live throughout the season on the primary host — cherry — and alatae, born in summer, migrate and form colonies on a secondary host. In Ontario, according to the author's observations, the favourite secondary host is *Lepidium apetalum* (wild peppergrass). He collected several *M. cerasi* from this weed and succeeded repeatedly in transferring it from the cherry to peppergrass. There is no doubt that other crucifers serve as summer hosts. In insectary experiments the author successfully established colonies of *M. cerasi* on *Capsella Bursa-pastoris*, *Brassica arvensis* and *Erysimum cheiranthoides*, but the results have not yet been verified in the field.

369 - **Sweet Sorghum Varieties Resistant to the Corn Earworm, in the United States.** — See No. 279 of this Review.

370 - ***Perezia mesnili* n. sp., a Protozoan Parasite of the Larvae of the Large White Cabbage Moth (*Pieris brassicae*), in France.** — PAILLOT, A., in *Comptes rendus des séances de la Société de Biologie*, Vol. LXXXI, No. 2, pp. 66-68, 1 fig. Paris, 1918.

The paper describes a new microsporidium found in the larvae of *Pieris brassicae* collected in the Sathonay-Rillieux, Lyons, district. It attacks exclusively the Malpighian tubes and the silk glands of a fairly small percentage of the larvae of the macrolepidopteron. The author places this protozoan temporarily in the genus *Perezia*, but under the name of *P. mesnili* n. sp.

371 - ***Hyperecteina polyphylla* n. sp., a Dipterous Parasite of the Injurious Coleopteron *Polyphylla fullo* in Russia.** — VILLENEUVE, J., in *Bulletin de la Société entomologique de France*, No. 17, pp. 306-309, Paris, 1917.

Mr. Z. GOLOVIANKO, of Borispol (Russia) published at Kiev, in 1916, a study, printed in Russian and illustrated with many figures, on the development of two flies, one of which, in the larval stage, is saprophagous on a lead lamellicorn beetle, *Polyphylla fullo*; the other, parasitic on the same coleopteron, lays its eggs on the stomach of the living animal.

The author, taking as basis material sent to him by Mr. GOLOVIANKO, as ascertained the saprophagous dipteran, represented by two females, to belong to the genus *Sarcophaga*; this cannot be positively stated as there were no males.

The parasitic dipteran is an undescribed species which also exists in France; it belongs to the genus *Hyperecteina* and is closely allied to *H. mephina* Schiner, for which it has been mistaken. The author describes the insect under the name of *H. polyphyllae* n. sp. He possesses a male of this new species taken at Cape Breton (Landes) by Mr. J. DE GAULLE and as examined the two females sent by Mr. GOLOVIANKO.

372 - ***Cosmopteryx phaeogastra* n. sp. and *C. bambusae* n. sp., Microlepidoptera attacking Beans and Bamboo respectively, in India.** — MEYRICK, E., in *The Entomologist's Monthly Magazine*, Vol. LIII (3rd Ser., Vol. III), No. 642 (No. 35) pp. 257-258, London, November, 1917.

This paper gives a morphological description of: —

- 1) *Cosmopteryx phaeogastra* n. sp., from larvae mining blotches in leaves of beans, at Pusa,
- 2) *C. Bambusae* n. sp., from larvae mining blotches in the leaves of bamboo, at Pusa.

373 - **Citrus Pests in Surinam.** — See No. 300 of this Review.

374 - ***Rhynchites bacchus*, a Coleopteron Injurious to Apples, Apricots and Plums, in Sicily.** — DE STEFANI, T., in *Nuovi Annali di Agricoltura Siciliana*, Year VI. Ser. 6, Pt. 4, pp. 178-191. Palermo, 1917.

Repeated observations made by the author during a number of years shows that very serious damage is caused in the orchards of the mountains of Renda, in the Monreale district (province of Palermo), by the curculionid *Rhynchites bacchus*, and, to a much lesser degree by other insects of the same genus, such as *Rhynch. giganteus*, *Rhynch. auratus* and *Rhynch. ruber* (1).

Rhynch. bacchus attacks apricots and plums but especially apples. During many years the harvest was completely lost, and the author observed that the whole crop of apples and plums may be destroyed in about a week.

On apples and apricots the insect lays many eggs, but, according to the author's observations, only one on plums. Having laid its egg on the plum, the insect cuts the peduncle in about the middle, thus causing the fruit which is to feed the larva to fall to the ground. In apples and apricots, however, it either cuts the peduncle partly or not at all, so that the fruit dries up on the tree, falling only during wind or the autumn rains. Damp causes the fruit to soften and decompose, enabling the larvae within to enter the soil and complete their metamorphosis there.

All the insects do not lay eggs in good time. They do not, however, die during winter, but hide in a sheltered spot where they await spring, and the attack the fruit as soon as it has set. The author has found specimens of *Rhynch. bacchus* in November, December and January.

From many dried-up apples containing larvae of this coleopteron picked from trees by the author, emerged in September two parasitic hymenoptera, *Eupelmus degeeri* and a member of the genus *Syntomaspis*, which may form a new species. The former was present more frequently than the latter, but always in limited numbers, which leads the author to believe that these natural enemies are not really of importance.

The best methods of control are to collect the fallen fruit, each day at the same time in all infested orchards, and to pick that which is attacked but is still on the tree. The larvae in this fruit should then be killed. As a means of obtaining the desired result without total loss of the product, the author advises that the infested fruit be boiled and then given as food to pigs.

(1) See B. Aug. 1912, No. 1249; B. July, 1914, No. 693. (Ed.)

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